GOVERNMENT OF INDIA · MINISTRY OF AGRICULTURE

PLANT PROTECTION

Bulletin

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"SCIENCE IN PRACTICE"

ISSUED BY DIRECTORATE OF PLANT PROTECTION, QUARANTINE AND STORAGE, NEW DELHI

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PLANT PROTECTION

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Vol. I, No. 1. SEPTEMBER, 1949.

ISSUED BY DIRECTORATE OF PLANT PROTECTION QUARANTINE AND STORAGE

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*N.B.—Articles, Reports, Notes, etc., against which authors are not indicated, have been prepared in the Directorate of Plant Protection, Quarantine and Storage of the Ministry of Agriculture, New Delhi. Any correspondence relating to these items should be addressed to the Plant Protection Adviser to the Government of India, New Delhi. Correspondence regarding other articles should be addressed to the writers concerned.

ERRATA

Introduction,	Line 4. Read " Storage " instead of " Storrge."
Page 1,	Line 26. Read " Circumstances " instead of "Circumastances."
Page 2,	Line 31. Read " under " instead of " uuder."
Page 4,	Line 9. Read " benzene hexachloride " instead of " bezone hexachloride."
Page 4,	Line 9. Read " 0·25 per cent." instead of " 16 per cent."
Page 4,	Line 29. Read "foot-rot " instead of " foot root."
Page 5,	Line 15. Read " Broom Rape " instead of "Brome Rape."
Page 5,	Line 20. Read " Woolly " instead of " Wooly."
Page 5,	Line 20. Read " Potato moth " instead of " Potato borer."
Page 5,	Line 24. Read " kakki " instead of " Takki."
Page 5,	Line 45. Read " obviously " instead of " oviously."
Page 7,	Line 23. Read " epidemics " instead of " epidemcs."
Page 8,	Line 26. Read " different " instead of " difierent. "
Page 9,	Line 3. Read " complement " instead of " compliment."
Page 9,	Line 36. Read " disease free setts for seed purposes " instead of " disease free seed purposes."
Page 10,	Line 4. Read " fluosilicate " instead of " flousilicate."
Page 10,	Line 14. Read " sprayings " instead of " spraying."
Page 10,	Line 17. Read " trees " instead of " tree."
Page 11,	Line 35. Read "very light attack of " instead of "very light of."
Page 13,	Line 39. Read " spread " instead of " spreads."
Page 16,	Line 13. Read " *sphenarioides* " instead of " *sphenaioides*."
Page 16,	Line 23. Read "year" instead of " years."
Page 17,	Line 9. Read " *H.*" instead of " *Hs.*"
Page 17,	Line 14. Read " efficacious" instead of " efficaceous."
Page 18,	Line 7. Read " as " instead of " ss."
Page 18,	Line 8. Read " sulphur " instead of " aulphur."
Page 19,	Line 12. Read "was commenced" instead of " were commenced."
Page 19,	Line 38. Read " 1 : 800 of water applied " instead of ' 1 : 800 applied."
Page 21,	Line 27. Read " affected " instead of " affetted."
Page 22,	Line 14. Insert fullstop between " control " and " Diseased."
Page 22,	Line 18. Insert comma between " 43 " and " Anjana."
Page 22,	Line 19. Read " percentage " instead of " percentages."
Page 22,	Line 31. Read " Improvement in drainage " instead of "Improvement, drainage."
Page 23,	Line 1. Delete " respectively ".

Page 23,	Line 45.	Insert fullstop between "up" and "In."
Page 23,	Last line	Read "infection" instead of "infected."
Page 27,	Line 18.	Read "Kerosenised" instead of "Kerosonised."
Page 28,	Line 17.	Read "during" instead of "durig."
Page 29,	Last line.	Read "behaviour" instead of "behavior."
Page 30,	Line 22.	Read "to control citrus psylla" instead of "to control of citrus psylla."
Page 31,	Line 8.	Read "thrips" instead of "strips."
Page 32,	Line 19.	Read "dioxide" instead of "dioxide $_2$".

INTRODUCTION

The Plant Protection Conference attended by Directors of Agriculture and Plant Protection Officers of the Provinces and States in India and held on 12th January 1949, recommended that the Central Directorate of Plant Protection, Quarantine and Storrge should keep all workers in India informed of the progress of control work on pests and diseases in different parts of the country and of the advances and developments in plant protection work in other parts of the world. It was, therefore, recommended that the Directorate should issue a quarterly bulletin which later on may develop into a monthly publication. The Government of India have accepted this recommendation. The bulletin will contain articles, reports, notes, observations and comments communicated by qualified workers all over India. The Central Directorate will also publish articles on specific pests or diseases and on the use of various pesticides after collating the information received from various parts of the country. Similarly, brief notes on advances made in the development of pesticides and plant protection machinery in various parts of the world will be published for the information of the workers in India. The notes from correspondents may also be in the form of suggestions, queries, and opinions, even tentative, offered for discussion or consideration. The reports should in particular contain information on the sudden outbreak of diseases or pests or the equally sudden disappearance of other diseases and pests from a particular area. The progress made in spraying, dusting and other methods of disinfestation should form a prominent part of the reports. The intensity and severity of a disease or pest, or the absence of a pest or disease from a particular area and the prevalent conditions should be noted.

If some varieties of a crop are not affected by a disease or pest, whereas others occurring in the vicinity have been attacked by them, then such information would be extremely useful. All matters, therefore, which may be of value to plant protection workers, should be included in the reports.

New quarantine regulations promulgated in India and other parts of the world and a digest of the old ones which require to be brought to the notice of workers in this country will also find space in this bulletin.

The success of the Plant Protection Bulletin will entirely depend on the co-operation of Plant Protection Officers, Mycologists, Entomologists, Plant Pathologists and other extension staff of the Departments of Agriculture and Rural Development throughout India.

Reports, notes, summaries, comments, etc. will be properly credited to the reporting authorities. Suggestions for the improvement of this bulletin will be welcome.

All material for the Plant Protection Bulletin should be marked ' for P. P. B. ' and addressed to the undersigned.

HEM SINGH PRUTHI,

Plant Protection Adviser to the Government of India
and
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Plant Protection Bulletin.

Vol. I, No 1.

PROGRESS OF PLANT PROTECTION WORK IN INDIA

(Dte. P. P. Q. & S., New Delhi)

India's deficiency in food production to meet the needs of her increasing population has come into prominence since the last World War. At present we are importing a little over 2½ million tons of grains. The Ministry of Agriculture has been endeavouring to reduce the gap by stepping up food production through an extension of the area under cultivation and by providing more irrigation facilities, better manures, better seeds, etc. However. the extra food produced has been partially offset by several important factors including the damage to crops by pests and diseases. Growing crops and their products during storage, etc., are subject to the attack of numerous insect pests and diseases, wild animals, birds, rodents, etc., which on an average, cause in a normal year, a great deal of reduction (about 20 per cent) in our food resources and in some years, when some of the pests and diseases happen to appear in an epidemic form, the losses to the infested crops may amount to over 50 per cent. For example, the low yield of paddy due to a single disease (*Helminthosporium*) proved to be one of the major factors in causing the disastrous famine in Bengal in 1943. In 1946-47, the wheat rust epidemic caused a loss of about two million tons of wheat. The devastation that a locust infestation can cause is too well-known. It has been estimated that losses both to cash and food crops as a result of damage caused by all kinds of animal pests and plant diseases, amount to several hundred crores of rupees.

It was in view of these circumstances that the Indian Famine Commission (1945), and the Council of the Food and Agricultural Organization of the United Nations, have laid special stress on the importance of plant protection as being " the most important single factor " in stepping up food production immediately in an appreciable manner. Practical methods in the case of several pests and diseases of Indian crops are known by which such losses can be avoided. But efficient pest and disease control operations require proper plant protection organizations. Such organizations have not yet been established in most parts of India. Furthermore, not only have we to check pests and diseases indigenous to India, but we have also to take measures against the entry of those of foreign origin, which often prove more destructive. It was with a view to safeguard the interests of the country in these respects that the Government of India established in 1946-47 an organization, now called the Directorate of Plant Protection, Quarantine and Storage, on a permanent basis with the following functions :—

(i) to organize campaigns against migratory pests and diseases of agricultural crops of All-India importance, *e.g.*, locusts, birds, rusts, smuts, bunts, etc.;

(ii) to prevent the entry into India of new pests and diseases carried on imported plant material by sea, air and land routes ;

(iii) to regulate in co-operation with provincial authorities the inter-provincial movements of plants so as to prevent the further spread of pests and diseases to new areas ;

(iv) to regulate the importation of parasites for the control of crop pests ; and

(v) generally to assist Provinces and States in carrying out field operations against pests and diseases.

Plans of development of all aspects of plant protection and quarantine work were drawn up, designed to create in the course of five years a fully equipped organization. At present the organization has completed its third year, but owing to various circumstances, only two instalments of sanction have so far been received, and much of the equipment has not yet arrived. Though still under-staffed and not fully equipped, the Directorate has made appreciable progress which is briefly described in the following pages :—

Locust Control.—In 1939, the Government of India established on a permanent basis, a small Locust Warning Organization which now forms a division of the Directorate of Plant Protection, Quarantine and Storage. Its function is to study fluctuations in locust population in permanent breeding desert areas and to warn the Provinces and States when the locust is about to form swarms. The organization was reorganized at the beginning of the recently-ended locust cycle which started in 1940. For the first time the crops in India were saved from destruction throughout the duration of this cycle which lasted for about 7 years.

Control of the Fluted Scale in Peninsular India.—Experience shows that in the case of certain pests particularly of foreign origin, direct control by the use of mechanical or chemical means is either difficult or too costly to be undertaken on a large scale, whereas the utilization of the natural enemies of the pest is an efficient method of bringing them under check. The Fluted Scale (*Icerya purchasi*) which is found in India and several other parts of the world affords a very good example of such a pest. Originally a denizen of Australia, this scale insect got introduced by accident into California in 1860, where it spread rapidly and became a pest of the first magnitude of citrus orchards. After exhausting all known methods of control by chemical sprays, the U. S. Department of Agriculture sent entomologists to the various Pacific Islands and to Australia in quest of the natural enemies of this scale in its original home. A predacious Ladybird beetle—*Rodolia cardinalis*. and a fly parasite—*Cryptochaetum iceryae*—were discovered in Australia and imported into California early during the present century and within a short time the pest was brought under control. At this time the scale had gradually spread almost all over the world—into France, Egypt, South Africa, Japan, Ceylon, etc., and everywhere the introduction of the Ladybird beetle controlled the pest.

The Fluted Scale accidentally got introduced into Madras in 1928 and became a serious pest of wattles in the Nilgiris. The Madras Government after trying methods of direct control, such as spraying, imported the predator

Ladybird beetle from California which apparently brought the pest under check by 1931. Unfortunately, not only the control operations were closed but no watch was kept on the scale. By 1941, the pest was reported not only in a serious form on the Nilgiris but to have spread to the Kodaikanal area of the Pulney hills also. Critical surveys revealed that the insect had spread also into Travancore, Mysore, parts of Madras and Coorg and even reached as far north as Poona. A co-ordinated scheme of mass breeding and release of the *Rodolia* beetle in the affected areas was sanctioned by the Ministry of Agriculture in 1946. A breeding laboratory was established at Bangalore under the technical control of the Plant Protection Adviser and the Ladybird beetles which were bred on a mass scale have been released during the past two years in all the infested Provinces and States by local organizations with the result that the pest has been brought under control and its spread into the valuable citrus-growing areas of Coorg and Central Provinces prevented. This scheme will continue to operate in Madras, Mysore, and Travancore, till the pest is controlled.

Cereal Rust Control.—In view of the severe outbreak of the black rust of wheat in 1946-47, a conference of the provincial Plant Pathologists, other experts and some officers of the Ministry of Agriculture decided to take concerted measures to bring it under control. The evolution of rust resistant varieties was agreed to be the best measure, but as it is of the nature of a long-term project and as resistant varieties do not remain resistant for long, it was decided to prohibit the cultivation of kharif wheat on the upland areas of south Bombay, Madras, Mysore, and Travancore, so as to prevent the over-summering in and conveyance of the inoculum from these areas to the *rabi* wheat in various parts of Peninsular India. This measure had been suggested by Dr. K. C. Mehta as a result of the research work done by him during the past 20 years. In conformity with this decision, steps were taken by the Governments concerned in 1948 to prohibit the cultivation of wheat and barley in the *kharif* season.

Unfortunately the prohibitory orders were enforced rather too late in certain parts of Madras and Mysore. Black rust appeared in the southern districts of Bombay province in December-January last and did some damage which was fortunately checked by the onset of drought conditions. The authorities of all the Provinces and States concerned have agreed to enforce complete prohibition during the coming summer.

General Plant Protection Work in the Provinces.—Till recently, the Provincial and State Agricultural Departments in India did not possess properly qualified Entomologists and Plant Pathologists, except in the major provinces of the U. P., C. P., Bombay and Madras. Even there, the small staff available was mostly engaged in research and teaching work at the Agricultural Colleges and there was no organization for carrying out control operations on a large scale in the cultivators' fields. The Central Plant Protection Organization soon after its establishment, prepared a scheme of Plant Protection Service to serve as a type suitable for an average province and circulated it to the various provinces recommending it for adoption to suit local conditions. This step was supplemented by visits of the Plant Protection Adviser and his deputies to almost all Provinces for helping them in the preparation of such

schemes. As a result plant protection work has been initiated in several of the provinces.

The first province to establish a comprehensive Plant Protection Service was the United Provinces where the Organization has now been working for over a year. Plant Protection Stations have been set up at four centres in the province: Ranikhet, Lucknow, Meerut and Gorakhpur. Successful campaigns against some pests and diseases of sugarcane, mango-hoppers, and citrus psylla were carried out in 1948. Pyrilla was controlled with benzone hexachloride mango-hopper with 16 per cent DDT emulsion and citrus psylla with tobacco decoction.

In the Bombay province, plant protection work started in 1946-47 under a Grow more food scheme, for the control of grass hopper pests. Successful dusting operations with BHC against the Rice grasshopper (*Hieroglyphus banian*) in Belgaum district were carried out in 1948 over an area of 10,000 acres, effecting a saving of about forty thousand maunds of paddy. The Rice grasshopper is widely distributed in India, particularly the western region. The Government of Bombay has recently sanctioned the establishment of a comprehensive Plant Protection Organization for work on all important pests and diseases and this organization has started functioning from April 1949.

In Madras, small schemes for the control of some pests and diseases of vegetables and of paddy, under the G. M. F. Campaign, have been in operation for over two years. Large scale operations have been carried out against chilli thrips, potato early blight, paddy foot-rot, damping off of tobacco, etc. In October last, a campaign against the Rice grasshopper (*Hieroglyphus banian*) by dusting BHC over 800 acres in Kistna district resulted in an overall net saving of rice worth about Rs. 40,000.

In West Bengal, schemes of seed-dressing with Agrosan and yellow cuprocide for the prevention of smut, foot-root and root-rot diseases of various cereals were taken up. Successful spraying against the blight disease of potato with Dithane and Perenox and a battery of hand sprayers reinforced with about half a dozen power-sprayers was carried out over an area of 5,000 acres during 1948.

In Ajmer-Merwara a scheme of seed-dressing with Agrosan for the *kharif* cereals was successfully carried out in 1948, the object of the treatment of seed before sowing being the prevention of the attacks of several diseases of the germinated seedlings. The crop raised from treated seed also showed greater vigour, and the cultivators were so convinced of the efficacy of the treatment of the *kharif* seed that there was a demand for such treatment for the *rabi* seed also, and over 6,000 maunds of wheat seed were given dressings and distributed.

Campaigns against the Phadka grasshopper (*Hieroglyphus nigrorepletus*) pest carried out over 3,000 bighas by dusting with BHC resulted in saving the entire field of the treated area.

In Coorg, Plant Protection scheme aimed at the saving of valuable citrus orchards and the control of various pests and diseases of paddy has been

in operation under the G. M. F. Campaign. Over 4,000 acres of citrus orchards were protected during 1948 from the Leaf and Fruit fall disease by large-scale spraying with Bordeaux Mixture resulting in high yields. Large areas of paddy were successfully sprayed with 1·25 and 2·5 per cent DDT for eradicating armies of the hairy caterpillar *Nisaga simplex* attacking it.

Control of noxious weeds.—Very little work has been done in India on the eradication of weeds that infest our pastures, irrigation channels, water courses, ponds, tanks, streams and rivers. Losses which weeds cause to crops by robbing them of soil moisture, fertilisers, space and sunlight are very high. The notorious Water-hyacinth not only has made navigation and irrigation difficult by clogging the channels, streams and rivers, but has proved an impediment to pisciculture, as fish cannot be raised in ponds, tanks and lakes infested by this weed. In the United Provinces, the ' baisuri ' weed (*Pluchea lanceolata*) has thrown out of cultivation a large extent of valuable land in the western districts. ' Brome rape ' (*Orobanche*) and *Striga* parasitize and damage such valuable crops as tobacco, jowar and sugarcane. *Hariyali, kans*, etc., are other weeds which also need immediate eradication.

Foreign Quarantine Work.—Several of the pests and diseases and noxious weeds found in India are of foreign origin. Some of these are San José Scale, Fluted Scale, Wooly aphis, Potato borer, etc., and among diseases Coffee rust, Blister blight of tea, Flag smut of wheat, *Fusarium* rot of paddy, etc., and various virus diseases of potato. Among noxious foreign plants introduced into India may be mentioned *Lantana*, *Eupatorium* Water-hyacinth, Takki weed, prickly pear, etc.

It is, therefore, necessary to prevent the entry of foreign insects or diseases. In the case of insects, the additional precaution of subjecting the suspected articles to fumigation has to be taken up, and in the case of diseases the suspected plants will have to be kept under quarantine observation in a glass house before they can be released after suitable treatment, if necessary or possible.

To tighten the preventive measures against the entry of foreign pests and diseases that may endanger the economy of the country, up-to-date fumigation houses and quarantine stations are proposed to be established at the main sea-ports of Bombay, Calcutta and Madras and at the points of entry by the land routes. Arrangements are complete for establishing such a station at the port of Bombay. Plant Quarantine stations for detecting the entry of latent diseases through plant imports are proposed to be set up at Poona and Calcutta in the first instance.

Regulation of Inter-provincial Movements of Plants (*Domestic Quarantine*).—Some pests and diseases of foreign origin are yet confined only to certain particular parts. For instance, the Fluted Scale is now found distributed in Madras, Travancore and Mysore only, the San José Scale mainly in Kashmir, the Himachal Pradesh and a few hill stations in eastern India ; the Late Blight of potatoes is confined to the hills of Northern India and the Flag Smut of wheat only to parts of East Punjab. It is oviously essential that such pests and diseases should be segregated in the area of occurrence and should not be allowed to spread into other parts of India. The Central Directorate is, therefore, taking measures to carefully regulate the inter-provincial movements

of plants, in co-operation with provinces and States concerned if necessary, by legislation. Rules under the Destructive Insect Pest Act are in operation to prevent the spread of San José Scale and Fluted Scale.

Training of Personnel.—To train personnel, regional courses in Entomology and Plant Pathology including demonstrations of large scale methods used in controlling pests and diseases and in storing food and seed grain have been given at Nagpur in June 1948, and at Ajmer in March 1949. About 150 officials of various Departments and cultivators attended the course in each region. Similar courses will be given in other parts of India during the current year.

Intensification of Plant Protection Work.—Only a beginning has been made in plant protection work in many parts of India. The work has to be considerably intensified in order to obtain quick results. A conference of the Directors of Agriculture and Plant Protection Officers of Provinces and States was, therefore, convened at New Delhi about middle of January last. The main recommendations of the conference are given below :—

1. India's total losses by damage caused to food crops by pests and plant diseases, which are at least twice as great as the quantity of cereals the country has to import from abroad at heavy cost, can be prevented to a great extent by controlling such pests and diseases.

2. For carrying out control operations adequately on a field scale, the establishment of a proper Plant Protection Organization in every province and State would be essential.

3. Since insect pests and plant diseases do not respect political boundaries and their occurrence in a particular area, especially in an epidemic form, will have definite repercussions in other areas and since it is, in many cases, necessary to have pest and disease control operations co-ordinated and organized on a regional rather than on a provincial or State basis, it was felt that the Central Government should play a more active role in plant protection work than in other spheres of agriculture. To ensure this, it was recommended that the Central Plant Protection Organization should be considerably strengthened.

4. The Provinces and States should prepare and send to the Plant Protection Adviser their annual programmes of plant protection work. and also intimate to him estimates of their requirements for pesticides every six months by 31st January and 31st July respectively. This would enable him to calculate the total quantities of pesticides required for the whole country and to make the necessary arrangements for their timely importation in bulk and their distribution to the provinces and States needing them.

5. It was also felt that there should be a central pool of power-operated plant protection machinery to supplement the resources of provinces and States. For such machinery as the provinces and States may wish to buy themselves, it was suggested that indents

for these also should be sent to the Plant Protection Adviser, so that orders may be placed with firms and their importation expedited.

6. Rapid field trials of various new pesticides, spraying, dusting and other machinery should be undertaken by the Central Plant Protection Organization.

7. With regard to Liaison Officers, such provinces as already possessed well-established plant protection services did not think the appointment of Liaison Officers necessary for their areas, while the States warmly supported the proposals for their appointment. Ajmer, Nagpur and Asansol were recommended as suitable centres for locating their headquarters.

8. To ensure effective co-ordination of work, periodical conferences of plant protection workers should be held. Provinces and States should prepare quarterly reports in respect of the occurrence of insect pests and plant diseases and the control measures taken. Such reports should be sent to the Plant Protection Adviser who should issue a consolidated report reviewing the work for the whole of India. This review should also incorporate information on developments in plant protection work in other parts of the world that may be of interest to India. In the case of the incidence of pests of a migratory nature, like locusts and army worms or of widespread epidemics like those of the wheat rust, the provinces concerned should immediately advise the Centre and the neighbouring provinces or States so as to enable them to take the necessary precautions for controlling them.

9. For intensifying plant protection work, trained personnel was essential. While many of the provinces considered that they had adequate arrangements of their own for such training, all the States as well as some of the provinces desired the Central Plant Protection Organization to take steps to organize plant protection training on a practical and tutorial basis.

10. Dr. Pruthi explained the recommendation of the London Conference on Grain Storage convened by the Food and Agriculture Organization and indicated the work required to be carried out by the Central and Provincial Plant Protection Organizations respectively. The meeting unanimously accepted his suggestions.

PLANT PROTECTION SERVICE, UNITED PROVINCES

(K. B. Lal, Entomologist to Government, U. P. and Officer-in-Charge, Plant Protection Service, U. P., Kanpur)

Object and Organization.—The Plant Protection Service of the United Provinces was sanctioned by the Provincial Government as a five-year Scheme with effect from the 1st April, 1947, with the following objects :—

1. To organize control operations against some major pests and plant diseases on field scale in different parts of the province.
2. To assist cultivators to obtain promptly and cheaply chemicals and equipment for controlling pests and plant diseases and to provide them with technical advice and supervision in their local, day-to-day problems of plant protection.
3. To demonstrate effective methods of pest and plant disease control on the fields of the cultivators and to educate them to adopt such methods as a routine in agricultural practice.
4. To warn cultivators against the possibility of pest and disease outbreaks and to persuade them to adopt timely measures against such outbreaks.
5. To devise and assist in the enforcement of quarantine and legislative measures against the entry and spread of pests and plant diseases in the United Provinces.

The main features of the scheme are as follows :—

1. Progressive increase in the staff and expenditure of the scheme during the first three years, thereby enabling it to run in full swing during the fourth and fifth years and thereafter.
2. Establishment of six Plant Protection Centres in difierent parts of the province, in addition to the main headquarters at Kanpur to provide operational bases for conducting campaigns against pests and diseases as well as to facilitate intelligence about the outbreaks of pest and disease attacks on crops, etc.
3. All control operations to be undertaken at Government expense during the first two years.
4. To ensure prompt mobility of staff and equipment from one area to another and for other reasons, the whole scheme is to be completely under one unified control, namely, that of the Entomologist to Government, U. P.
5. Each of the 49 districts of the United Provinces to have a Junior Plant Protection Assistant (Rs. 120—250), and Agricultural Supervisor (Rs. 75—120) and three field attendants (Rs. 25—35). Each Plant Protection Centre to be in the charge of a Senior Plant Protection Assistant (Rs. 200—350), with an additional Agricultural Supervisor.

Staff and Expenditure.—The Plant Protection Service started functioning in August 1947. During 1947-48 the sanctioned staff of all grades numbered 74 and during 1948-49, 152. The Service is to acquire its full compliment of staff of 269. including three gazetted officers, in its third year (1949-50). The cost of the Plant Protection Service, excluding the cost of control measures, is to be Rs. 10,71,000 recurring, spread over a period of five years, but the non-recurring expenditure, originally estimated to be Rs. 44,900, is likely to be about Rs. 3,79,210 by the end of 1949-50, after which no major items of non-recurring expenditure are anticipated. This rather high increase over the original estimates has been due to the need for purchasing large number of power spraying and dusting machines which are the major items of non-recurring expenditure. For the cost of control measures, which includes cost of insecticides, fungicides and other chemicals and materials, labour and transport, a provision of Rs. 3,51,875, has been made for the five-year period, 1947-52. During 1947-48, a sum of Rs. 31,181 was actually spent on control measures against a provision of Rs. 21,000 originally made. During 1948-49 the provision of Rs. 44,300 for control measures is likely to be spent out. The total amount actually spent on the Plant Protection Service during 1947-48 was Rs. 65.938 against the sanctioned budget of Rs. 1,16,896. The total amount most likely to be spent during 1948-49 is Rs. 1,94,443 against the sanctioned budget of Rs. 2,17,620.

Campaigns against pests and diseases.—During the last 19 months (August 1947 to February 1949) that the Plant Protection Service has been in existence, field-scale operations have been conducted against various pests and diseases, the more important of which are the following :—

1. Pyrilla pest of sugarcane in Meerut and Muzaffarnagar districts during August-November 1947, and in Hardoi and Meerut districts during May and June 1948. Methods employed : Dusting with Gammexane, spraying with DDT and bagging. Total area covered in actual operations, exclusive of the area surveyed : about 874 acres.

2. Red rot disease of sugarcane in nine districts of the central and eastern United Provinces during November-March 1947-48, and again in Basti, Azamgarh, Banaras, and Jaunpur districts during July-February 1948-49. Methods employed : Roguing of diseased plants, selection of disease free seed purposes and propaganda. Total area rogued during 1947-48 : 6,415 acres, area selected for seed : 2,299 acres. Total area rogued during 1948-49 : about 580 acres. Reports about the area selected for seed are not yet available. (The antired-rot campaign in 1947-48 as well as that against the Pyrilla was carried in collaboration with the Cane Development Department, U. P.).

3. Ear cockle disease of wheat in Meerut district during March-April 1948. Methods employed : Roguing and burning of the diseased plants and dusting with Gammexane. Total area covered about 140 acres.

4. Grasshoppers damaging sugarcane, paddy, maize, juar, bajra and sawan crops in Azamgarh district during July, August and September 1948. Methods employed: Poison-baiting with sodium flousilicate and bagging. Total area covered: about 246 acres.

5. Army worms damaging wheat and barley crops in Mirzapur district during December 1948. Method employed: Dusting with Gammexane. Area dusted: about 20 acres.

6. Aphids attacking mustard crops in Kanpur district during January 1949. Area sprayed with tobacco decoction: 40 acres.

7. Mango hoppers in Lucknow district during April and May 1948, and in Lucknow, Barabanki, Faizabad, Farukhabad, Meerut and Saharanpur districts from February 1949 onwards. Method employed: Spraying with DDT. In 1948 about 756 mango trees were sprayed. In 1949 the spraying are still in progress: the reports so far received indicate that 3,639 trees have already been sprayed.

8. Powdery mildew disease of mango in Lucknow during April 1948 Method employed: Dusting with sulphur. Some large tree and several hundreds of seedlings were dusted.

9. Smuts and barley crop. Method employed: Treatment of seeds with Agrosan GN. Seed treated: 1,799 maunds at four farms in Rae Bareli, Hardoi, Meerut and Azamgarh districts during October and November 1948.

10. Crop pests and diseases in the hills. About 9½ acres of potato and 4½ acres of til and mandua crops, and 360 citrus and 626 apple trees were treated against various pests and diseases at various times by spraying, dusting and other methods. During the summer of 1948, a total area of about 121 acres in some orchards of Nainital and Almora districts was cleared of a wild plant, called 'golden rod' as a measure of control against the peach leaf curling aphis.

Besides the above, various minor operations were carried out against Citrus psylla, Red pumpkin beetle, Brinjal shoot borer, fruit tree bark borer, gram cutworms, field rats, late blight of potatoes and many other pests and diseases in different parts of the province. These operations were undertaken on a small scale—not because the losses involved were minor, but because the existing resources of the Plant Protection Service could not adequately meet the demands made on it. Indeed, the surveys made and information collected under the Service as well as contacts made with the public through participation in agricultural fairs and exhibitions and in other ways, have revealed only too clearly the widespread need and growing demand for combating pests and plant diseases.

WHEAT RUST SITUATION IN INDIA DURING 1947-48

(Dte. P. P. Q. & S., New Delhi)

The following is a summarised account of the wheat rust situation in the various provinces of India during the year 1947-48. This is based on the reports received from the different provinces in response to a request made by the Central Directorate.

East Punjab

All the three rusts, black, brown and yellow were recorded in the East Punjab. The yellow rust was the earliest to appear and in a majority of the areas was more virulent and caused greater damage in comparison with the other two. Generally speaking, the relative severity of the rusts in East Punjab was greater than last year; *e.g.* the extent of damage in Ambala, Gurdaspur and Ferozepur was 125-150 per cent and about 250 per cent of the preceding year, taking that year's incidence as 100.

Delhi

In Delhi only a mild attack of yellow rust was reported. The severity was estimated to be only 10 per cent of what it was in 1946-47.

At the farm of the Indian Agricultural Research Institute, Delhi, however all the three rusts were reported. The yellow rust was very severe, the other two being milder.

United Provinces

In the United Provinces, the yellow rust was the earliest to appear. The severity of rusts was, however, much less than in 1946-47 and ranged between 5 to 25 per cent in a majority of cases. Only in the eastern districts of Gorakhpur and Partabgarh, it was moderately severe, about 30 to 40 per cent of what it was in the previous year.

Bihar

In Bihar all the three rusts appeared, but brown rust was more common and more virulent, and was the only rust recorded in Sabour, Gaya, and Shahbad. The severity of the rusts in general was much less than in 1946-47 and ranged between 5 to 30 per cent with an average of about 12 to 13 per cent only.

Central Provinces and Berar

In the Central Provinces and Berar, mostly the black and brown rusts occurred, the only exception being Raipur, where only traces to very light of yellow rust were noticed. In other areas the two rusts, black and brown, appeared either simultaneously or the black rust appeared earlier. The black rust was also more common, and comparatively more virulent. The severity of rusts in general was much less than in 1946-47 and ranged between 5 to 20 per cent with an average of about 10 per cent only.

Bombay

Black and brown rusts were reported from Poona ; the black appeared earlier in the plains and the brown in the hills, but the infection was very light, being 2 to 15 per cent only.

Madras

Plains.—In Bellary district in the north, brown and yellow rusts were common but infection was very light. Towards the south in Coimbatore both black and brown rusts appeared and were about as severe as in 1946-47.

Nilgiri and Pulney Hills.—All the three rusts were reported from the Nilgiris and they appeared at about the same time, the black rust was virulent on *Triticum vulgare* and the brown on ' samba ' causing 80 to 100 per cent damage.

In Kodaikanal only traces of brown rust were reported.

Mysore

In Mysore black and brown rusts were common. The black rust was earlier to appear and caused greater damage than brown rust.

Travancore

Yellow and black rusts were present in the Travancore State. The yellow rust was earlier to appear, and the severity of rusts in general was less as compared to the last year, being about 30 per cent of what it was before.

Orissa

No wheat cultivation has been reported at any of the experimental stations and as such there has been no record of the incidence of rusts.

Coorg

No wheat cultivation has been reported in Coorg.

West Bengal

All the three rusts were present in some part or the other of West Bengal. The black rust usually caused greater damage. The severity of rusts in general was much less than last year, and ranged between traces to 25 per cent, the only exception being in the district of Kalimpong where it was 100 per cent, *i.e.*, as it was in 1946-47.

General

It may be stated in general terms that the severity of rusts in the various parts of India during the year 1947-48 was much less than it was in 1946-47 when, as described above, an epidemic of black and brown rusts was recorded in central and peninsular India and the neighbouring areas. The only notable exception was the Punjab where yellow rust was more severe.

RUST SITUATION IN PENINSULAR AND CENTRAL INDIA AND RAJPUTANA IN 1948-1949

(Dte. P. P. Q. & S., New Delhi)

Three members of the staff of the Directorate of Plant Protection, Quarantine and Storage, were sent to different parts of peninsular and central India and Rajputana in order to survey the rust incidence in *rabi* wheat especially that of Black rust. The following objects were principally kept in view :—

(i) detection of the first appearance of the disease in the field,

(ii) location of the sources and spread of the disease, if possible, and

(iii) observing the subsequent development and direction of spread of the disease.

The staff toured throughout the areas mentioned during the months of December to March 1949, starting from the Madras Province, Mysore State and Bombay in the south and ending in Rajputana in the north. Information was also received from various correspondents in the area and the news furnished by them have been made use of in writing this report.

It should be stated that in certain parts of the Madras Province, the Mysore State, and in the districts of Dharwar and Belgaum of the Bombay Province, two crops of wheat are usually grown in a year—the summer crop and the regular winter crop. The summer crop is sown in parts of Madras (the Nilgiris and the Pulneys) in the month of April, but in Mysore State and the districts of the Bombay Province already mentioned, summer wheat is sown sometime after the monsoon has started, that is, during the middle of June. Harvest commences some time in July-August in the Nilgiris and the Pulneys, and extends up to the end of September in the Mysore State and Bombay Province. The second and major crop is sown between September and October in the plains of these areas and harvested between the middle of February and the end of March, depending on the locality. The crops are raised both in irrigated and non-irrigated areas. It may be stated that in the major wheat growing areas of India wheat is sown during October-November and harvested in March-April.

Weather Conditions.—The weekly air temperatures in the plains of north Madras, Mysore, and adjoining areas ranged between 66 to 87°F. during December. In the Nilgiris and the Pulney hills, however, the temperatures were much lower, being 49 to 69°F. during the same period. Intermittent rains and cloudy days were frequent and conditions for rust infection were very favourable. January and February throughout the area were rather dry.

Black rust appeared in the first or the second week of November in the plains of Madras, Mysore and Bombay and spreads northwards. The following table will give an idea of its spread :—

Province or State	District	Dates of first appearance of rust
Madras	Bellary	1st to 2nd week of November
	Coimbatore	Ditto
Mysore	Chitaldroog	Ditto
	Kadur	Ditto

Province or State	District	Dates of first appearance of rust
Bombay	Belgaum	1st to 2nd week of November
	Dharwar	Ditto
C. P. & Berar	Chanda	December
	Yeotmal	January
	Buldana	January
	Akola	January
	Khandwa	End of January
	Jubbulpore.	End of January
	Saugor	End of January
Rajputana	Udaipur	1st or 2nd week of February
	Jaipur	Middle or third week of February

Distribution of the Three Rusts

(i) *Black rust*

The black rust of wheat was severe in North Madras (Bellary district) and Coimbatore, in north Mysore (in Chitaldroog and parts of Kadur districts) and the Dharwar and Belgaum districts of the Bombay Province. In the Nilgiris and the Pulneys, during this period, black rust was not in evidence.

Central Provinces and Central India.—Proceeding north in the Central Provinces and Central India, black rust was severe in the southernmost district, that is, in Chanda and was moderate in Yeotmal, Buldana, Akola and Khandwa districts. It was observed only in traces in the northern districts of Jubbulpore, Hoshangabad, Saugor, Ujjain and Indore.

Rajputana.—Further up in Rajputana, black rust was present in traces to none, in Udaipur, Ajmer, Jaipur and Alwar.

(ii) *Brown rust*

Peninsular India and Bombay.—Brown rust was associated with black rust and was generally light to moderate, occasionally severe in north Madras, Mysore and Bombay. According to the Plant Pathologist, Bombay, brown rust did more damage this year to the wheat crop in the Bombay province than black rust. In the Nilgiris and the Pulney hills, at altitudes of 6,000—7,000 feet, brown rust was fairly prevalent but infection was usually light or only in traces. At lower elevations of about 5,000 feet above the sea level, however, moderate to severe infection was noticed.

Central Provinces and Central India.—In the Central Provinces and Berar, in the districts of Chanda, Yeotmal, Buldana and Akola, brown rust was very light or only in traces, the only exception being Khandwa where light to moderate infection was observed. Further up north in Jubbulpore and Saugor, it was negligible or entirely absent.

Rajputana.—Infection by brown rust was light in southern Rajputana and only in traces in the northern states of Ajmer-Merwara and Jaipur.

(iii) *Yellow rust*

Peninsular India and Bombay.—Yellow rust was not observed anywhere in the plains of peninsular India or Bombay, but it was common in the Nilgiris at altitudes between 6,000 to 7,000 feet. It was present only in a few places and infection was usually light.

Central Provinces and Central India.—Yellow rust was not observed anywhere in the Central Provinces or Central India except in Khandwa where traces of it were present.

Rajputana.—Yellow rust was not observed in southern and Central Rajputana but it was observed in traces in Jaipur. In the Alwar State, in the north, it was in traces to very light.

GENERAL CONSIDERATIONS

It was observed that incidence of rusts in irrigated areas was higher than in the unirrigated areas in the same locality.

The earliest appearance of rust was in November in north Madras, Mysore and the adjoining districts of the Bombay Province. At that time, the crop was still in the seedling stage. Because of the intermittent rains and cloudy days the rust spread and became severe within three to four weeks. In December to January, it was so severe in certain of these areas that the crops had dried up, but the effects being more pronounced following dry periods. It would appear that inoculum spread to the neighbouring southern districts of C. P. and Berar probably through Hyderabad from these areas. Proceeding further up north, the appearance of rust was delayed and the severity decreased, probably because of the late arrival of inoculum and at a time when the weather was not favourable. During late December, January and February, the weather was rather dry in the northern parts and apparently did not favour the development of rust.

In hilly tracts of the Nilgiris and the Pulneys, the lower temperature in those areas at that time probably did not favour the development of black rust although light infection by brown and yellow rust was seen.

CONTROL OF GRASSHOPPER PESTS IN WESTERN INDIA DURING 1948

(Dte. P. P. Q. & S., New Delhi)

Among the pests of paddy, millets, etc., grasshoppers are very important. At irregular intervals serious outbreaks of these pests occur over large areas and the losses are indeed very high. For example, in 1947 the whole of the rice area in Belgaum district of Bombay Province was infested with the Rice grasshopper and the yield in some parts fell below 5 per cent. Even during the years which are not marked by outbreaks, the losses due to them are sufficient to class them as major pests.

The grasshoppers which greatly damage the cereal crops in India are : (i) Rice grasshopper (*Hieroglyphus banian*), (ii) Phadka (*Hieroglyphus nigrorepletus* and (iii) Deccan Wingless grasshopper (*Colemania sphenaioides*). Very often associated with the Rice grasshopper is the allied species *H. oryzivorus*. Of these, the Rice grasshopper is common in the more moist areas and infests mainly paddy and sometimes sugarcane. On the other hand, *Phadka* and the Deccan Wingless grasshoppers are confined to the drier areas and devastate rain-fed crops like maize, jowar, bajra and other small millets.

All the three grasshoppers have some common features in their life histories. The eggs are laid in the soil in clusters or pods sometime before the setting in of the winter season. They lie there till after the break of the monsoon rains in the following years. When the soil becomes sufficiently moist, development inside the eggs proceeds quickly and in 10 to 15 days time, the tiny hoppers emerge and wriggle out to the surface of the soil. Soon feeding becomes their main pre-occupation. As they grow, they moult 6 to 8 times, till in 7 to 9 weeks they become full-grown. All these species of grasshoppers have only one generation in the year. The winter and the pre-monsoon parts of the following year are passed in the egg stage as described above and there are practically no hoppers at that time of the year.

Control Campaign

In the Province of Bombay the grasshopper menace was heavy and widespread, and two species were concerned. The Rice grasshopper was serious in Belgaum district over an area of above 25,000 acres under paddy. The young hoppers were dusted with BHC (Hexyclan 5 per cent) in an area of about 10,000 acres and the pest was completely controlled to the satisfaction of the cultivators who paid one-third of the cost of the insecticide. The quantity of dust used was 12 to 15 lbs. per acre depending on the growth of the paddy crop. Most of these operations were conducted through the agency of the Multi-purpose Societies.

The Deccan wingless grasshopper, which is a pest of drier areas, was found infesting maize, jowar and bajra in the districts of Belgaum, Dharwar and Bijapur where dusting operations against it were carried out over 16,387 acres. The total area infested was about 150,000 acres. In the case of this grasshopper 7 per cent Hexyclan was found to be more effective and that too when the pest was young. In view of the dryness of the atmosphere

and the comparatively larger bulk of the crop, 18 to 20 lbs. of the poison dust per acre were found necessary. In the circumstances, the control of this grasshopper was not effective on the whole but valuable experience was gained for future campaigns.

It is estimated that control operations against these two grasshoppers in Bombay province gave an additional yield of about 2,500 tons of cereals valued at about Rs. 81,000. On account of short supply of reliable dusting machines much of the infested area under maize and jowar could not be covered.

The grasshopper pest Phadka (*Hs. nigrorepletus*) has become within the last three years or so a serious pest of maize and jowar in Ajmer-Merwara and in the adjoining areas of Udaipur, Jodhpur and Kishengarh States. A campaign against this pest was carried out. The young hoppers were dusted over a crop area of about 3,000 bighas in the different parts of the Province and BHC at 15-18 lbs. per acre proved very efficaceous. The cultivators were convinced of the success of this method of control. It is proposed to carry the campaign over a larger infested area during 1949.

In the Kistna district of Madras province, the paddy crop was infested with the Rice grasshopper. Action was taken and the crop, over an area of 800 acres, was dusted with BHC. It is estimated that rice worth about Rs. 40,000 was saved through these control operations.

The Rice grasshopper (*H. banian*) seriously affected the paddy crop in the Raipur area in the Central Provinces. The pest was detected rather late when it had done most of the damage to the standing crop.

The dusting operations were carried out in all the areas mentioned above with hand operated dusting machines. Experience has shown that such machines may be quite practicable when the area to be treated is small, but when one has to undertake large scale operations, small and easily portable power operated dusting machines are necessary. Arrangements are being made to obtain samples which will be tested on field scale during next year.

SEED TREATMENT OF CEREAL CROPS IN 1948

In many of the fields where cereals are grown, it is usual to find many gaps due to the failure of the seed to germinate or subsequent death of the seedlings. In a majority of cases such mortality is due to pre-emergence-rot, damping-off, foot-rot, root-rot or seedling blight. Such seedling diseases can usually be effectively controlled by treating the seed with some fungicidal dressing, such as organic mercury compounds, copper compounds, organic compounds of sulphur, or pure sulphur itself. Some of the important seed dressings are Agrosan GN, Yellow Cuprocide, Spergon and Arasan, and if the seed is thoroughly smeared with any of them, a complete and effective control can be obtained in a majority of cases.

In order to make seed dressing a success it is essential that the fungicide should be in as finely powdered a form as possible. As a rule the powder should pass through a sieve with two to three hundred meshes per linear inch. The powder is applied at the rate of 2 to 5 ounces per maund of the seed grain. For applying it, seed treating drums should be used. They are half filled with the grain and the required quantity of the seed dressing is then added. The drum is then rotated for 4 to 5 minutes and the seed is then ready for the seed drills.

During 1948 seed treating operations were carried out in the provinces of Delhi, Coorg, Bombay, Madras, United Provinces, West Bengal, Orissa and Ajmer-Merwara. Thousands of maunds of rice, wheat and jowar were treated before the seed was sown in the fields. In almost all cases the reports received indicated that the stands were good, that there were fewer gaps, and the resulting crops themselves were very healthy. The treated plants were better able to withstand attacks even by air-borne organisms which was not the case with untreated crops.

Due to the paucity of adequate quantities of seed dressings and also for want of enough seed dressing machines, larger quantities of seed could not be treated. However, enough fungicide has been stocked this year and a firm in Bangalore has undertaken to manufacture seed dressing drums of 15 gallon capacity at Rs. 65 each, f.o.r. Bangalore. It is hoped that larger quantities of cereal seeds and also seeds of vegetables and leguminous crops, would be treated during this year in all those provinces where plant protection schemes are functioning.

PLANT PROTECTION WORK IN AJMER-MERWARA IN 1948*

(i) Insect Pests

(G. N. Bhatia)

1. The Phadka Grasshopper (*Hieroglyphus nigroreplctus*).—This is the most serious insect pest in Ajmer-Merwara and it was estimated that about 75 per cent of the villages were infested by it. The precise estimated area was calculated to be 112,707 acres and the loss caused was Rs. 60 lakhs. Egg masses were located from February 1948 onwards, at various places in Ajmer-Merwara and attempts were made to remove as many egg masses as possible from three Government farms. The removal of egg masses reduced the infestation when compared with adjoining fields. Dusting with 5 per cent BHC. were commenced in July and lasted until October. Dusting machines and the poison were also distributed at 15 different centres in Ajmer-Merwara. About 3,000 bighas of infested land were dusted in 104 villages and about 3 to 4 tons of poison were used. The food of the pest, extent of infestation and estimation of damage were studied. The laboratory and field trials were made with DDT-410 (Geigy), Gammexane D.025, Gammexane D.034, Hexyclan, Sodium fluosilicate, and a mixture of Gammexane D.025 and Pyrethrum in the proportion of 4 : 1.

Both Hexyclan 5 per cent and Gammexane D.025 proved efficacious against the pest. The cultivators were convinced of the efficacy of this insecticide and they wanted that all their fields should be treated. It was noted that two dustings were necessary, one at the rate of 5 to 10 lbs. per acre on the bunds of the newly hatched hoppers and second at the rate of 20 lbs. per acre on the crop when the grasshoppers had migrated into the fields. From the economics worked out, the dusting operations were fully justified. Gammexane D.034 was less effective and DDT 410 (Geigy) was slower in action but gave good results. Sodium fluosilicate being a stomach poison took too much time for bringing a complete kill and was less convincing to the cultivator. Gammexane and Pyrethrum mixtures also gave good results.

The major difficulty in carrying out operations over large area was lack of funds for the purchase of insecticides and dusting machines, booking and transport difficulties and insufficient field staff. The scheme of work for 1949-50 has been modified in consultation with the Plant Protection Adviser and submitted to the Government for sanction.

2. *Bagrada picta*.—At Nasirabad, cauliflowers and their seedlings were heavily damaged by painted bugs in June 1948. Application of nicotine sulphate at the rate of 1 : 800 applied with a knapsack sprayer proved useful. The same treatment against affected cauliflower seedlings was tested at Jethana with equally good results.

3. *Mustard Saw-fly*.—The larvae of this insect were found causing serious damage to seedlings of cauliflower, radish and turnips in November 1948.

*Work under a scheme for plant protection in Ajmer-Merwara was started in February 1948.

The growing of cauliflower is an industry in Ajmer-Merwara. They ripen very early and are exported to Bombay and other places. Light dusting with 5 per cent BHC on the seedlings in the beds proved effective and saved the seedlings.

4. *Cutworms.*—Cutworms were causing serious damage to cauliflower plants and wheat seedlings in December 1948 in low lying areas. Dusting with BHC 5 per cent round about the plants gave complete control.

(ii) Plant Diseases

(M. M. Gaur)

There was some difficulty in persuading cultivators to treat their seed against smuts and other diseases because they were afraid of the poisonous nature of some of the seed dressings. Extensive propaganda, however, was carried out and several thousand maunds of *kharif* seed (jowar, bajra and maize) were treated in several villages with about 600 cultivators co-operating in the effort. Though the *kharif* crops failed during the year due to the paucity of rains and attack of Phadka, but still the treated crop gave very good germination and a good initial growth which convinced the cultivators of the usefulness of the seed treatment. During the survey of treated crops, it was noted that there was not a single smutted head of jowar present while infection in untreated plots was 20 to 40 per cent.

Treatment of rabi crops.—During *rabi* season it was decided to treat all the wheat seed distributed through the Department, the target of which was 15,000 maunds. But for want of staff and enough fungicides, only 6,600 maunds of wheat were treated and distributed to the cultivators. Reports and results of survey work carried out indicate that the treated crops are growing vigorously and satisfactorily.

A preliminary survey of plant diseases was carried out in Ajmer-Merwara during 1948-49. The following diseases of economic importance were noticed on cereal crops :—

Crop	Disease	Cause	Incidence
1. Wheat	Black rust	*Puccinia graminis*	Light
	Brown rust	*Puccinia triticina*	Light
	Loose smut	*Ustilago tritici*	0·5 per cent
	Flag smut	*Urocystis tritici*	Traces
	Yellowing rot of ears	*Bacterium tritici*	Light
	Ear-cockle	*Anguillulina tritici*	Light to moderate
2. Barley	Loose smut	*Ustilago nuda*	Traces
	Covered smut	*Ustilago hordei*	Traces to light

Crop	Disease	Cause	Incidence
3. Jowar	Grain smut	*Sphacelotheca sorghi*	5 to 25 per cent
	Long smut	*Tolyposporium ehrenbergii*	Traces
	Red leaf spot	*Colletotrichum graminicolum.*	Moderate at Kekri; traces to light at other places
4. Maize	Downy mildew	*Sclerospora philippinensis*	Light to moderate
5. Bajra	Green ear and downy mildew	*Sclerospora graminicola*	Up to 10 per cent in badly affected fields
	Rust	*Puccinia penniseti*	Traces
	Smut	*Tolyposporium penicillariae.*	Traces

Besides the above, powdery mildews were common on cucurbits, lady's finger, and certain spice crops such as *Cuminum cyminum*, *Coriandrum sativum*, and *Trigonella fœnumgræcum*.

Flag smut of wheat was observed in a field at Ramsar near Ajmer. The disease, however, could not be located elsewhere. This is the first record of the disease in Ajmer-Merwara Province.

A wilt disease of cumin, probably due to *Fusarium* sp., was observed to be causing severe damage to the crop at Kekri. The general incidence of the disease varied from 25 to 40 per cent, but in certain fields the infection was as high as 75 per cent. The diseased plants turned yellowish and later there was a complete or partial drying of the plants. The affected plants could be easily pulled out. The roots bore dark-brown markings and pink coloured sporodochia were observed on several of the affected roots. Cumin wilt due to *Fusarium* sp. has probably not been recorded from elsewhere except from Bulgaria, where the fungus is reported to have been isolated from the affetted tissues.

NEW AND KNOWN DISEASES IN THE UNITED PROVINCES IN 1948

(U. B. Singh, late Plant Pathologist to Government, United Provinces and D. N. Garg, Junior Plant Protection Officer, United Provinces.)

1. *Ufra Disease of Paddy in United Provinces.*– Mention of this serious disease of paddy from United Provinces was made by Mr. P. K. Dey, former Plant Pathologist to Government, United Provinces, in the Annual Administration Report 1929-30 of the Department of Agriculture, United Provinces. It caused quite an appreciable damage in the Rice Research Station farm at Nagina, from the middle of July to the end of August 1948, and also in the Lalitpur Farm, Ganga Khader and Mowana in the district of Meerut. The disease is due to an eelworm, *Anguillulina angusta*, and was reported by Butler in 1913 as occurring in the great rice-growing deltaic tract at the head of the Bay of Bengal. In 1919 he described the rice worm and suggested methods for its control Diseased samples received from Nagina and Latitpur showed in most cases infestations in varying degrees at the collar as well as in nodes up in the plants.

At Nagina the following varieties of rice, *viz.*, A-64, T.1, T.136, TN.22 T.2, H54/1-2/1, T 43 Anjana Mainpuri Batri, and Anjana Pilibhit were found affected with eelworm. Percentages of infection of the following varieties, *viz.*, A.64, T.1, T.136, T.43, TN 22, and T 21 was noted down and was 20.5, 6.0, 22.4, 15.4, 12.4, and 10.2 respectively.

At Latitpur, Ganga Khader and Mowana, the disease was found in wet and flooded fields. Here all paddy was grown by broadcasting. In a few fields damage was as high as 50 per cent while in others from 20 to 25 per cent but the majority of paddy fields were found free from disease. In some fields the infection was 2 to 5 per cent. The following varieties were grown, *viz.*, T.27, T.64, T.21 and T.27, and one unknown type and all were found affected in varying degrees.

The following tentative control measures were recommended :—

1. Uprooting and burning of all affected plants.
2. Improvement, drainage, as the disease increases in water logged areas due to the ability of worms to swim in water from affected to healthy plants.
3. Burning of affected stubbles after paddy is harvested as the worm is inactive during cold months in the stubbles.
4. Use of worm-free seed.
5. Ploughing down of stubbles. There is a prospect of their speedy decomposition and consequent death of worms as it is unable to live long in moist soil.

2. *Disease of Berseem : Cuscuta arvensis* appeared in an epidemic form on berseem causing severe damage at the Government farms at Haldwani,

Nawabganj and Bareilly respectively. Suitable methods of control as given below were advocated and a scientific article was published, *viz.*, (i) " Dodder or love vine of berseem in the United Provinces ", (*Current Science*, September, 1948, 17, pp. 267 to 268). *Cuscuta arvensis* Bey is controlled by growing (*a*) dodder-free seed, (*b*) avoidance of dodder-free berseem fodder, (*c*) preventing the grazing animals from infested to clear fields, (*d*) restricting the flow of irrigation water, (*e*) avoiding the use of dodder-containing manure, (*f*) destruction of the crop by burning before seeding, and (*g*) by leaving the ground fallow after the selected eradication measures have been completed and then following a five-year rotation beginning with a non-leguminous tilled crop.

3. *Die-Back and Wilt Disease of Guava.*—This is a very serious disease in most guava growing tracts of the United Provinces and has been responsible for wiping out many a well established guava orchard. It has been recorded from eleven districts of the United Provinces. A species of *Fusarium* has so far been found responsible for this disease. A good measure of success has been obtained by cutting off the already affected branches at least one foot below the last point of infection and after smoothening the cut surface, painting it with Chaubattia paste (4 oz. Copper carbonate : 4 oz. red lead : 5 oz. lanoline). Cut diseased branches should be collected together and burnt.

4. *Rice Blast* (*Piricularia oryzae* Cav.).—The disease was observed on paddy in Nagla Jailal village, district Etawah, during the first week of November 1948.

Symptoms : Lesions on the neck of the culms and on the panicles near the base are characteristic symptoms of the disease.

The disease causes much damage as the lesions prevent kernel filling Small, circular, blackish-brown lesions are seen on the kernels and also on seedlings. In case of severe infection leaves and sheaths dry out and become brown.

5. *Powdery Mildew of Mango* (*Oidium mangiferae* Berthet) —The mildew of mango was first noticed on leaves and inflorescences in March 1948 at Lucknow. Later it was also observed in Allahabad.

Symptoms : The fungus causing the disease forms a floury coating on the leaf on both the surfaces, covering all or a considerable part of the leaf. Affected leaves dry up and lose their green colour, just as in the powdery mildew of peas. In case of severe attack both the size and the number of fruits are reduced.

6. *Root-Rot of Berseem* (*Pellicularia filamentosa* (Pat.) Rogers) —In April 1948 the fungus was found causing a severe root-rot of Berseem at Nawabganj (Bareilly). It was also observed in cultivators' fields at some distance from the farm.

Symptoms.– In the early stage of the disease the parts attacked are the roots and the crown, where a slight discolouration is produced which gradually deepens to black. By this time the leaves and branches of the plant begin to wither. In a later stage the bark of the crown dries up In advanced stages sclerotia are formed on and near the crown. In case of severe infected

seeds remain shrivelled and in a number of plants the seeds are not formed at all. (*Current Science*, Volume 17, pp. 270, 1948.)

7. *Bunchy Top Disease of Mango.*—The disease was observed in March 1948 in Sikanderbagh garden, Lucknow and also at Kanpur.

Symptoms.—The leaves of a badly infected plant are bunched together at the apex of the plant to form a rosette. In the inflorescence all the floral parts become leafy and there is no setting of fruits. In an year-old affected plants, sometimes, many of the roots decay and die. The affected plants are markedly stunted and there is little growth in height, once the plant is attacked by the disease.

YELLOWING ROT OF WHEAT EARS

(Dte. P. P. Q. & S., New Delhi)

A yellowing rot of wheat ears caused by *Bacterium tritici* (Hutch.) Elliot was reported for the first time in 1917 by Hutchinson from the Punjab under a local name 'tannan' or 'tandu', the disease has been considered to be of minor importance and its exact mode of transmission is as yet unknown; there is evidence to show that it is usually associated with eelworm attack. Hutchinson had remarked that the incidence of the disease should be kept under close observation in order to prevent it from being a disease of major importance.

On February 9, 1948, the yellowing rot was observed in a serious form at Bhilswa, a village near Delhi. The affected crop was dwarfed and the plants were weak and pale. In some fields the incidence of affected ears was over 50 per cent and the damage caused was very appreciable. The appearance of the disease in such a severe form was apparently due to the fact that during September-October 1947, the area was under floods, and in the absence of proper drainage, conditions favourable for the development of the disease were created.

On 24th February 1948 the disease was observed in several fields in Mangaspur, about 20 miles from Delhi, where its incidence varied from 5 to 10 per cent. This locality was, however, not subjected to the floods and there were no signs of any faulty drainage.

The wheat crop was again inspected at Bhilswa during February 1949. Potato, gram, and peas were found growing in the fields where wheat had been raised in the previous year. Several other wheat fields were examined in the locality and the yellowing rot disease was observed in all of them, the incidence varying from 10 to 20 per cent. Symptoms of eelworm infection were usually observed on affected plants. As a large number of plants had not developed ears on the day of inspection (10th February 1949), it is possible that the incidence of yellowing rot later on was greater than that recorded above. The disease was present in other villages of Delhi province and in Ajmer-Merwara.

The above observations show that the yellowing rot of wheat which hitherto had been considered to be a minor disease is now becoming widespread. As the disease is of a serious nature, it deserves fuller investigation.

CONTROLLING *BHINDI* YELLOW VEIN MOSAIC IN POONA

(Dte. P. P. Q. & S., New Delhi)

In Poona as elsewhere in India a mosaic disease of *bhindi* known as Yellow Vein mosaic is very common and destructive to the crop. Affected plants are stunted, the veins of the leaves are turned yellow, the plants look very unhealthy and yield a very poor crop. As *bhindi* is a very commonly used vegetable and is available throughout the year, any disease which lowers its yield causes a good deal of loss not only to the farmers but also to the consumers.

This disease has been under investigation at the Virus Research Laboratory at the College of Agriculture, Poona, and it has been discovered that in nature the virus responsible for Yellow Vein mosaic occurs only on one other host which is a weed, a relative of the *bhindi* plant, namely, *Hibiscus tetraphyllus*.

The vector of the virus is the white fly, *Bemisia tabaci*, which has a very large host range, and therefore it is not possible to eradicate it by any easy means. The only procedure, therefore, is to control the virus itself by eliminating it from the area. For this purpose it was decided by the Bombay Department of Agriculture to conduct a large scale trial in Poona during April and May. During this period no *bhindi* was permitted to be grown anywhere around the Poona city and the staff employed visited all the kitchen and other gardens to uproot old or newly sown *bhindi* plants, as also the weed relative of this crop. In some cases some compensation was paid to the farmers. When the crop was sown at the usual time, that is towards the middle of June, it was noted that the incidence of the disease was less and large yields of the *bhindi* crop were obtained.

PLANT PROTECTION WORK IN HIMACHEL PRADESH

A. S. Gilani, Director of Agriculture (Himachel Pradesh, Simla) has sent the following interesting note:—

In Sirmur district the potato crop in certain parts of Pachad and Renka is attacked every year by *Epilachna* beetle. This pest makes its appearance in the months of May and June, lays eggs on the lower surface of the potato leaves, which hatch out into hairy larvae. They damage the crop by eating away all the green leaves. Last year tobacco decoction spraying was tried but the effect was only temporary. Trials with Gammexane D.025 were made at the rate of 15 to 25 lbs. per acre but did not prove a success. It is proposed to try Guesarol 410 and other chemicals like Paris green, Lead arsenate, etc.

In Chamba a medium-sized beetle (yet unidentified), about $\frac{1}{2}$ inch in length attacked peaches, grape vines, plums, etc. Its body is dark-green and glitters in the sun. During the last four years it has done very great damage to fruit crops. All the fruits in a tree are attacked and made unfit for marketing. The beetle is nocturnal in habits. During the beginning of the rains in 1948 the beetles were trapped with strong light traps with kerosonised water in the gardens. In three days time all the beetles were killed and the fruit crop was saved.

LOCUST SITUATION IN INDIA DURING 1948

(Dte. P. P. Q. & S., New Delhi)

The swarms of Desert locust (*Schistocerca gregaria* Forsk) have been appearing in India periodically from times immemorial. The belt of this locust extends from India through the middle East countries up to North East Africa. The last cycle which started in 1940 terminated in India in 1946 after which no swarms have been observed any where either in the Indian Dominion or Pakistan. However, some swarms are still found in Oman and Trucial Coast, western Saudi Arabia and near the Red Sea Coast in East Africa. The Locust Warning Organization which was considerably expanded during the cycle has been reduced to the minimum strength of staff necessary for keeping watch over the fluctuation in population of the pest in the desert areas.

Of all the ecological factors which help to develop mass growth, crowded breeding of locust, rainfall is the most important. Records of the past 115 years in this country do not support the possibility of any regular periodicity in rainfall, a very large percentage of which occurs durig June to September (Ramdas, *Empire J. Exp. Agric. 1946*). Hence in years when the rainfall is heavy and widespread the solitary locusts in the outbreak centres get favourable conditions for breeding on a large scale and are able to build up high concentration within one or two seasons and thus form incipient swarms. If the weather conditions still continue to be favourable these swarms migrate into the neighbouring provinces and states and settle down to breed in areas which have previously received good rainfall and where the soil conditions are suitable for egg-laying; otherwise their number dwindles and the population soon comes down and may even become negligible.

Before the partition India had two breeding zones of locust *viz.*, (1) spring breeding area of southern Baluchistan and (2) summer breeding area of Sind-Rajputana. After partition, the Rajputana and Saurashtra States were left with the Indian Dominion. Because of the vastness of this area, about twice as large as the Sind-Baluchistan area, homogeneity of sandy soil, richness of flora and some degree of rainfall either from the south-eastern or south-western monsoon it forms an important zone of locust breeding.

Rainfall conditions being unfavourable during 1947, no large scale breeding occurred anywhere in Rajputana. During 1948 some slight showers of rain were received in winter spring in the north-eastern Rajputana and the weather conditions on the whole remained dry; hence no breeding was observed. Monsoon rainfall was heavy in the north-eastern Rajputana than in the West, maximum being 9·10″ at Sardarshahr (Bikaner State) during August. In the second fortnight locust population began suddenly to rise and the maximum density of 8,720 locusts per square mile was observed at Lohawat (Jodhpur State) on the 18th June. This sudden rise in population was due to immigration of newly bred locust adults from beyond the Indus-River. Towards the close of the month, the population began to decline and in July stood at 2,640 at Sardarshahr (Bikaner State) on the 26th. Though conditions were favourable at a number of places, no large scale breeding occurred anywhere due to the absence of swarms or high concentration of solitary locusts. However solitary breeding was observed in some localities. Hoppers of various stages

were discovered in Barmer-Shergarh sector of Jodhpur State and west Bikaner where the population of first and third stage hoppers in one locality was 100 to 300 per square foot. As the number of these hoppers was alarming suitable control measures were soon organized and breeding brought under control. The survivors from this area and the scattered hoppers from other areas fledged into adults and once again raised the local population to 38,400 locusts per square mile during the season in Bikaner State and to 2,480 in Jaisalmer State where the rise was due mainly to the immigration of locusts from the adjoining Bikaner State. Some locusts migrated into Jodhpur State but their number was not appreciable. With the onset of dry conditions during autumn these locusts got scattered and their population began to decline in October and became negligible during November and December.

According to the article 4 of the Anti-Locust Convention signed between India and Iran on the 14th August 1947, the First Consultative Meeting between the two countries was held at Tehran last year. Among the important decisions taken are (i) present cessation of locust plague should not be taken as ended but only as a temporary respite, hence concerted action with respect to location and prevention of incipient swarm formation in the outbreak areas to be continued in each country, (ii) region of Mekran in Pakistan and Iranian Mekran bordering Pakistan should receive closer attention by the Government of both countries, (iii) Anti-Locust organization in each country to be strengthened both in personnel and transport wherever necessary and any tendency towards swarm formation to be checked and signalled to the neighbouring countries and (iv) India to undertake intensive research into the behavior and control of the Desert Locust.

PLANT PROTECTION NOTES AND NEWS

Jaipur. According to Mr. R. L. Mathur, Assistant Mycologist, Department of Agriculture, Jaipur, loose smut of wheat appears to be common in Jaipur State. The loss, he says, may be between 1 to 2 per cent on an average. The loose and covered smuts of barley are also common and, during the past year, it would appear that the loss due to loose smut alone may be up to 5 per cent whereas covered smut occurred to the extent of 1 to 2 per cent. In an experiment to test barley varieties for their reaction to these smuts, it was noted that J. B. S. 29 was less susceptible than the others.

A new disease of barley known as '*Molva*' has been reported from Torawati area of Jaipur. The affected plants remain stunted, develop empty or light ears and die prematurely. Knotting of the roots is also common. The disease has not yet been completely diagnosed.

Zira (*Cumin* sp.) is annually attacked in Jaipur by a blight. All the aerial parts of the plants are affected. Diseased plants bear no seed or if seed is produced it is much shrivelled and is of dark colour. This is a very serious disease and is more harmful than the powdery mildew which also occurs in Jaipur.

The bajra crop in Jaipur State is stated to be attacked by smut, green ear disease, and rust. *Striga* has also been noted in the bajra fields.

East Punjab.—The Plant Protection Assistant, East Punjab, reports that to control of citrus psylla, 1607 trees were sprayed with rosin compound with considerable success. Nine hundred and fifteen citrus trees were sprayed with Bordeaux mixture against citrus canker. Nine thousand nursery plants were also sprayed with Bordeaux mixture against the same disease. Seven hundred and eight trees of peaches and apples were sprayed with diesel oil emulsion against San Jose scale. An extensive campaign against field rats was carried out over an area of 60,000 acres in 15 villages of Ludhiana district.

United Provinces.—Dr. K. B. Lal, Officer-in-Charge of the Plant Protection work in the United Provinces, reports that late blight of potatoes occurred over a wide area in the United Provinces, especially in Hapur and adjoining areas. Over a thousand acres of the crop appear to have been affected and in some cases there was a total loss of the crop. As late blight does not as a rule occur in the plains of India, operations against this epidemic could not be immediately undertaken as the reports were not received in time. There must have been some unusual conditions present in the area to cause this abnormal epiphytotic. The United Provinces Plant Protection Service is now well equipped with materials and personnel to cope with such sudden outbreaks and a late blight forecasting service will perhaps have eventually to be worked out.

Bihar.—Mr. A. C. Sen reports that the potato crop at Sabour was infested to the extent of 10 to 15 per cent by cutworms (*Agrotis ypsilon*). Two dustings with 3 per cent DDT brought the pest completely under control. The vegetable crops—cabbages and beans—were found to be infested to the extent of 70 per cent by *Plutella maculipennis* and aphids. Spraying with 5 per cent Pyrethrum solution gave cent per cent control after two operations.

Assam.—Mr. S. C. Chowdhury, Plant Pathologist, Assam, reports that the pea crop was attacked by rust and wilt in several parts of Assam. In mustard *Alternaria* blight appeared to be very common.

Miscellaneous.—Spotted wilt is a virus disease of tomatoes and very destructive to that crop in Australia. It is transmitted by thrips but it has been noted that the cherry tomato, *Lycopersicum pimpinelifolium* is resistant to spotted wilt. A hybrid variety of the commercial type between the ordinary and the cherry tomato has now been obtained in Australia which has strips resistant powers and it is expected that other high commercial varieties can be developed with similar resistant qualities, in which case the spotted-wilt problem will get licked in that country. (Dte. P. P. Q. & S., New Delhi.)

Farmer's Bulletin No. 1439 issued by the United States Department of Agriculture deals with 'Diseases of Cabbage and related plants'. First issued in February 1927, it has now been revised by Dr. J. C. Walker, of the University of Wisconsin. Club-root, root-knot, black rot, *Rhizoctonia* disease, powdery and downy mildews, and white rust are some of the diseases which occur in India and their account and methods of control are well worth perusal by Plant Protection Officers. There are also brief notes on damping off, leaf spots and boron deficiency diseases which are of common occurrence in the Nilgiris of the Madras Province.

Kenya plans to double its Pyrethrum production in 1949, with a target of 3,500 tons. It is reported that a large proportion of the estimated output has already been sold forward to the United States at 25 per cent above the 1948 price. Research is being conducted to determine if Pyrethrum may be used as a protective agent for foodstuffs in storage, and experiments are being made in Kenya with grain in silos and on West Africa with groundnuts, palm kernels and cacao. If the results are satisfactory, it is probable that demands will far exceed the combined production of Kenya, Uganda, Tanganyika, the Belgian Congo and Nyasaland. (Extract from the monthly report of the Indian Government Trade Commissioner in East Africa for February 1949.)

Mist blowers.—'Much better than anticipated' is the report of scientists, A. E. Dimond and S. F. Potts, on results of trials using a mist blower for the control of fungus diseases of plants. Working in New Haven, Dr. Dimond of the Connecticut Agricultural Experiment Station and Mr. Potts of the United States Department of Agriculture used the new technique last summer for controlling anthracnose on sycamores.

Mist blowers utilizing concentrated sprays are an effective new device for controlling insect pests of trees and plants. They have never, however, been used for shade tree disease control. Plant Pathologists believed that the behaviour of disease spores made it unlikely for them to be checked by this method.

Blowers deliver a fine mist of concentrated liquid which falls in tiny droplets, fairly widely separated. This is in direct contrast to the more dilute solutions deposited by conventional spray apparatus. Here, the droplets are larger and closer together.

They anticipate that mist blower usage for plant disease control, if it proves practical, will be most helpful in work with shade and street trees. The saving in time and labour as compared with hydraulic ring, should be considerable (Spra-Comments).

Grain Storage.—Commonplace signs of deterioration of grain in storage are when germination begins, when kernels show discoloration, or when kernel show punctures from insects. Germination accelerates respiration causing heat which can be felt, and intergranular air becomes humid and odorous. Immediate remedies are turning, cooling, and screening. Bin storage efficiency depends on keeping air convection currents in motion, and this is aided by having large wall areas free from girder work or offsets on walls. Corners of the building should be curved and walls vertical with smooth surfaces. These refinements facilitate downward movement of cool air. Hard concrete walls are better conductors than grain, and they radiate most of the heat to the outside atmosphere. A proper proportioning between wall areas and volume of grain is important for good storage. Prior knowledge of moisture content is essential before transferring grain to bins, and electrical thermometers in the grain ensure against rapid heating. Insect activity can be controlled by sampling intergranular air for excess carbon dioxide$_2$. Storage of moist grain must be avoided and rapid cooling after drying to retard respiration is advocated. Thorough cleaning of grain before storage is essential, and constant elimination of all material conductive to epidemic sickness in a grain bin is very important. Remodelling of old granaries and proper foresight in building new ones will do much to improve long-time safe warehouse of grain. (Milling'—110. 1948.)

OBITUARY

We regret to announce the death, due to typhoid, of Dr. Udai Bhan Singh, Plant Pathologist to the United Provinces Government, on March 26, 1949. Dr. Singh was an Associate of the Indian Agricultural Research Institute, and an M.Sc. and D.Phil., of the University of Allahabad. He was for several years (1934 to 1947) the Research Mycologist at the Fruit Experiment Station at Chaubhatia, United Provinces, where he did outstanding work on controlling the diseases of apples, pears and other hill fruits. He developed the 'Chaubhatia paste' which has successfully controlled the stem canker and rot of apples and pears. All Indian Mycologists and Plant Pathologists join in sending their condolences to Dr. Singh's family.

MGIPC—S5—12 Agri—30.6.50—500.

Plant Protection Bulletin

Vol. I, Nos. 2 and 3

OUTBREAK OF A FRESH LOCUST CYCLE

(Dte. P. P. Q. & S., New Delhi)

There was gregarious breeding in Eastern Arabia early in 1949. The locust population remained low in the desert areas of Rajasthan up to April 1949. A sudden rise was observed in the second fortnight of May due to influx of exotic locusts which had bred in eastern Arabia. This infiltration continued up to July-August raising the population almost everywhere, particularly in eastern Rajasthan.

Breeding of locusts is dependent on rainfall which besides providing suitable soil moisture for egg laying, encourages growth of wild vegetation which forms food for the newly hatched hoppers. If the rainfall is below normal, the vegetation is scanty and the conditions for breeding less favourable than when it is above normal. In the latter case besides providing luxuriant growth it makes the condition of soil moisture favourable everywhere and hence egg-laying occurs over wide areas resulting in incipient swarm formation within a period of 5-6 months.

The monsoon rainfall broke out all over Rajasthan during the last week of May and 1st week of June and was active in north-eastern Rajasthan. There was then a gap of about 3 to 4 weeks after which rainfall was heavy and widespread all over Rajasthan during July and first week of August. It was followed by drought conditions for about 5 weeks during which period vegetation suffered and began to dry. The monsoon was again active in the third week of September and was extensive and heavy both in eastern and western Rajasthan.

With the first shower of rain during the end of May and beginning of June migrants started egg-laying. Due to growth of thick vegetation the hoppers remained undetected till the middle of July and thereafter their occurrence became more frequent. Mass breeding was observed at Kaku-Badla-Hansasar area of south Bikaner and Ajasar-Rohena area of east Phalodi where hoppers which escaped destruction became adults. Since the weather conditions continued to be favourable further breeding took place at Loia-Haddan-Bholasar area of Kolayat Ji (Bikaner) and Amla (Phalodi).

Simultaneously breeding occurred in the desert areas of Bahawalpur, Thar and Khairpur Mirs State of Sind (Pakistan) and flying swarms began to be observed from middle of September onward. They were 2 or 3 in number. A few swarms entered north-west Jaiselmer State from the adjoining area of Bahawalpur and Khairpur Mirs (Pakistan) and since this area had received high rainfall in the end of September (about 15″ at Shahgrah) they settled down to breed.

As soon as the situation became serious all the available entomological staff of the Directorate of Plant Protection, Quarantine and Storage was deputed to help the staff of Locust Warning Organization in field work and sufficient quantity of fighting equipment, *viz.*, poison and machinery was procured and supplied.

The success of the anti-locust operations depends upon efficient motorized transport in order to locate concentrations and move necessary equipment and personnel to the site of breeding. As the transport available with the Locust Warning Organization (10 serviceable trucks) which have been in use since 1943 began to break down frequently, about half a dozen jeeps were secured by about the end of October. Of these only two are in serviceable condition in the deserts.

Locust breeding was in progress up to end of November near the Indo-Pakistan border in Jaiselmer and in Pugal area of Bikaner. With the assistance of Ministry of Defence and Ministry of States, arrangements were being made for despatching a sufficient number of light vehicles, etc. and the pest was controlled.

An International Locust Conference was held at Karachi from the 22nd to 27th October. The locust experts who had come from U.K., France, Egypt, Iran, India, Pakistan, thoroughly studied the Locust situation in each country and paid great attention to known and suspected areas of locust outbreak and territorial plans for survey and control during next year in different regions. They concluded that a new plague of the Desert Locust seemed to be beginning and if energetic steps were taken without delay to carry out control measures on a large scale and according to a co-ordinated plan there was hope that the development of another cycle could be arrested. With this object in view they made some recommendations for each country. The important recommendations requiring attention of the Government of India are :—(1) to participate in a joint Mission for locust survey and control campaign in the crucial area of Oman which affects Iran, India and Pakistan on the east and Aden, Yemen and East Africa on the west, by providing two new vehicles at a cost of about Rs. 24,000 and contributing a sum of Rs. 20,000 in cash as part of expenditure for machinery, control, transport, labour, petrol etc., (2) to strengthen anti-locust measures in India. In view of the developing locust cycle it was considered essential in order to arrest it effectively and quickly that the staff of the Locust Warning Organization should be increased considerably and it should be provided with sufficient transport and modern weapons of control. The Government of India accepted the recommendations of the Karachi Conference. They also sent an Entomologist to Oman and Southern Iran to study locust situation.

SOME CONCRETE RESULTS OF PLANT PROTECTION WORK IN THE UNITED PROVINCES DURING 1948-49.

(Dr. K. B. Lal, Entomologist to the Government, United Provinces, and Officer-in-Charge, Plant Protection Service, United Provinces).

During the period, April 1, 1948, to March 31, 1949, control operations on field-scale were carried out against various crop pests and diseases in the United Provinces. In order to assess the economies of these control operations in terms of the cash value of the crops, fruit trees, etc., saved from damage, against expenditure incurred, some calculations have been made, based on very low estimates of yields and damages. Even then the figures arrived at show unmistakably the enormous gains that can be achieved by properly and effectively controlling pests and diseases. In some cases, however, calculations in concrete terms have not been possible though even casual observers have been left in no doubt of the highly beneficial nature of the results. For example, campaigns carried out against the Red rot disease of sugarcane in certain of the eastern districts of the province (in collaboration with the Cane Development Department, U.P.) have led to marked and substantial reductions in the incidence of the disease in some of the areas where measures such as preserving clean seed, rogueing, etc. were properly carried out. In the Basti zone of Basti district the area of cane crop affected by the Red rot disease during the 1949-50 season has been only 7·9 acres (Basti area) against 256·0 acres during the previous season, thereby recording a considerable fall in the incidence of the disease.

The information that follows, therefore, is only in respect of those operations the results of which could be concretely evaluated at this stage of our organisational efficiency. Information about a large number of minor operations, however, which could be similarly evaluated, has not been included.

1. Control operations by means of bagging, spraying, dusting and stripping of dry leaves against the Pyrilla pest of sugarcane were conducted over 65 acres of crop. Assuming the average yield of sugarcane to be 400 maunds per acre, the price of cane at Rs. 1/10/- per maund and the improvement in the crop as a result of the control operations to be only 10 per cent, the cash value of the gain works out to be Rs. 36,575.

2. Spraying operations were conducted against the mango hopper pest on 11,554 mango trees at an average cost, including labour charges, of Rs. 1/0/2 per tree, totalling Rs. 11,726/7/6 for 11,554 trees. An average mango tree in this area yields fruits worth at least Rs. 25-30 in a season. A serious attack by the mango hopper leads practically to no crop. It is estimated that the spraying, which was highly successful, of one mango tree saved at least Rs. 20. Therefore the total amount of gain to the fruit growers was Rs. 2,31,080.

3. A campaign against grasshopper, attacking sugarcane, maize, *juar*, *bajra* and other crops, was conducted over 250 acres of crops. At the lowest

computation, this campaign must have saved at least Rs. 20 worth of crop or fodder per acre on an average. The total value of this gain, therefore, was easily Rs. 5,000.

4. A very bad attack of mustard aphis was effectively controlled by spraying 40 acres of mustard crop, sown mixed with wheat or gram at an average cost of Rs. 3/11/3 per acre, totalling Rs. 148/2/- for the entire 40 acres, including labour costs. Since the mustard covered only half of the area involved, only 20 acres have been taken into account for evaluating gains. The average yield of mustard is at least 8 maunds per acre and its price may be taken as Rs. 30 per maund. One had only to look at the affected crop to believe that there should have been practically no yield if there had been no spraying. The amount of mustard saved, therefore, was 160 maunds costing Rs. 4,800.

5. A campaign against field rats was carried out in several areas. Altogether 2,990 rat burrows were fumigated, including 229 fumigated a second time, at a cost of about 7 pice per burrow, including labour charges ; and 311 burrows were treated with poison baits, including 118 burrows treated a second time, at an average cost of about 13 pice per burrow, including labour charges. Assuming that there were only 5 rats in each of the burrows (generally, there are more, up to a dozen) and that each rat, if allowed to live and breed, caused damage by itself and through its progeny, to the extent of Rs. 2 worth of grain or plant and ignoring the damage done to water channels and bunds, the gain as a result of the anti-rat operations, in terms of money to the province works out to be Rs. 33,010 against Rs. 426 spent on raticides and labour charges for treating a total of 3,301 burrows of which 347 burrows were treated a second time.

6. In the Kamaun hills, 4,730 apple and other fruit trees were treated against various pests and diseases by various methods at an overall cost of pesticides and labour roughly estimated to be Rs. 979/3/6. The operations undoubtedly led to a general improvement in the condition of the trees and in their fruiting capacity. Converted into terms of money, this improvement could not be less than at least Rs. 10 per tree. The total value of the fruits saved, therefore, was easily Rs. 47,300.

7. As a preventive measure against foot-rot 1,999 maunds of wheat (including 26 maunds of barley) seed were treated with Agrosan GN at a cost of Rs. 463/10/- for the chemical and Rs. 180 for labour, totalling Rs. 643/10/-. Even if the disease normally did not appear subsequently (in some areas it did on crops raised from untreated seeds), the treatment is well known to lead to improved growth of crops and consequently to higher yields. Assuming the seed rate of wheat to be one maund per acre and the extra yield, as a result of the treatment, also to be one maund per acre only the net value of the gain, calculated at the flat-rate of Rs. 13 per maund of wheat, works out to be Rs. 25,987.

Conclusions

The figures of cash gains, even in the seven examples cited above, add up to Rs. 3,83,752 against the entire recurring expenditure of Rs. 1,35,240 incurred on the Plant Protection Service of the United Provinces during

1948-49. This, however, is not a fair way of comparing the gains of plant protection with the expenditure incurred, first, because calculations in respect of other control operations, large and small, which were also carried out, have not been made and, secondly, because the comparable expenditure should be only that incurred on three items, namely, pesticides, machines and labour. After all, the cultivator, who is himself ultimately expected to adopt control measures against pests and diseases, would have to spend his money exactly on these three items only and not on any plant protection organisation or technical advice or supervision.

From calculations it appears that about Rs. 16,000 was spent on various pesticides for control operations in respect of the seven items enumerated above. According to established practice in agricultural calculations the expenditure debitable to the use of spraying, dusting and other machines should be 10 per cent of their total price and this in the present case works out to be Rs. 2,020/-. Since much of the labour, both skilled and unskilled, was provided by the regular staff of the Plant Protection Service, 10 per cent of the salaries of the entire staff should be a fair indication of the expenditure incurred on labour. This figure amounts to Rs. 6,285. The total expenditure on pesticides, machines and labour, therefore, adds up to Rs. 24,305 which contributed to a cash gain of Rs. 3,83,752/-, that is, a return of about sixteen times the expenditure incurred.

In addition to the above-mentioned visible return from the Plant Protection Service, there are also some invisible gains the value of which cannot be ignored. In this latter category must fall the fact that an organisation has been built up in the province which is steadily getting equipped and experienced to undertake effective action on field-scale against crop and other pests and diseases and which must thereby create enormous confidence and incentive among farmers and fruit growers for minimising losses in their fields and gardens caused through the attacks of pests and diseases. For, the fight against pests and diseases can only be carried on by organised effort and intensified through accumulated equipment and experience. Recent experience has shown only too clearly how much can be lost in how short a time even when the crops and the fruit trees have been grown with the best of seeds, implements, manures and irrigation and on the most fertile of soils. Recent experience has also shown equally clearly how much can be saved by prompt and effective action against pests and diseases. This realisation has already started growing on the farmers and fruit growers of the United Provinces.

The pests and diseases of fruit trees in Kamaun against which operations were carried out are the following :—

(*i*) Woolly aphis (winter and summer sprayings with rosin soap and tobacco decoction respectively).

(*ii*) Peach leaf curling aphis (spring spraying with tobacco decoction against nymphs chiefly and large scale eradication of golden rod plants, the only alternative host known, from orchards).

(*iii*) Apple root borer (mechanical removal of grubs).

(*iv*) Stem borer of apple tree (fumigation of the borer holes with a mixture of chloroform and creosote).

(*v*) San Jose scale (spraying with diesel oil emulsion).

(*vi*) Tent caterpillar of apple (removal and burning of 'tents').

(*vii*) Stem brown, stem black, pink and collar rot diseases of apple trees (removal of affected branches and application of an antiseptic paste to the cut surfaces).

(*viii*) Lichen (spraying with caustic soda solution).

GRASSHOPPER CAMPAIGN IN INDIA DURING 1949

(Dte. P. P. Q. & S., New Delhi)

During the 1949 grasshopper season which started in July and came to an end in October-November, there were heavy infestations of three species of grasshoppers, namely, *Hieroglyphus banian* (Rice grasshopper), *H. nigroreplectus* (Phadka grasshopper) and *Colemania sphenarioides* (Deccan wingless grasshopper) in different parts of India. The infestation in each case was heavy and wide-spread where the trouble was anticipated and the preparations were made in advance, the control work was effective but in cases where the pest was observed or reported only after it had assumed serious proportions, the control work was inevitably patchy, depending on when and how much of the control equipment could be made available.

The Rice grasshopper (*Hieroglyphus banian*) was found to infest paddy in the provinces of Bombay, Madras, Coorg and the Central Provinces, the United Provinces and Assam. In Bombay Province the chief infested area lay in Belgaum district where an almost contiguous block of 25,000 acres of paddy fields was infested. The infestation was moderate but it was only over 15 per cent of the acreage in 1948. The chief reason for this fall in the degree of infestation appears to be the poison dusting operations undertaken over this area in 1948, most of the grasshoppers were killed before they could lay eggs. About 28,000 acres of the paddy were dusted with 5 per cent BHC, and practically the whole crop was saved from the ravages of this rather serious pest. In earlier years, *i.e.*, when such campaigns were not undertaken the yield from this area had gone down very low. This campaign in the Bombay province was on a subsidy basis, the cost of the poison dust having been shared equally by the cultivator, the provincial Government and the Government of India. About 10 tons of the poison dust were used, saving at least 40,000 tons of paddy. In addition, this operation is expected to reduce by half the infestation of the rice grasshopper in this area in 1950. A major operation against this pest was also carried out in the Madras province. Over 8,000 acres of paddy fields were dusted and the saving of the paddy is estimated at about rupees 8 lakhs.

The Phadka grasshopper is a denizen of the drier areas. Usually it lives and breeds among the wild grasses. In Ajmer-Merwara and Rajasthan its permanent abode lies in the jungle areas in the hilly region separating Ajmer-Merwara from the Jodhpur state in the east and Ajmer-Merwara and Udaipur states in the south-east. But during years of favourable climatic conditions their multiplication is such that the grasses there are not enough to sustain their numbers. It is then that they come down to cultivated areas and there, finding the vegetation more congenial to their well-being and propagation, they establish themselves. It seems this grasshopper came into the cultivated areas about ten years ago. The areas being agriculturally rather backward, this progress of the pest went unnoticed or unheeded so that the areas so infested increased year by year. Thus in 1949 the Beawar and Ajmer Divisions of Ajmer-Merwara had infestation almost all over and the Kekri division was free only where the soil was hard clay, or otherwise unfavourable. The portion of Kishangarh State lying south-east of Ajmer-Merwara was fully

and heavily infested. Such was also the case with those portions of Udaipur State and Shahpur which adjoin the infested areas of Ajmer-Merwara, etc. The pest has also infested the Jodhpur State, particularly the area adjacent to Beawar division. In Jodhpur State the infestation is still confined practically to the grasslands. It appears that the spread of the pest is wider than indicated above but outside these areas the menace is yet in an incipient stage. For example, in 1948 in the Delhi Province the Phadka was met with here and there as a harmless grasshopper. This year it has appeared as a crop pest in patches again here and there. That it is a potential pest for the Delhi province is evident from the fact that an alarmingly large number of them was present in the grassland in Delhi cantonment area.

This grasshopper has one peculiarity. More than 75 per cent of them in the final, *i.e.*, adult stage have only half wings. These must inevitably propagate in and about the place of their birth. The full-winged ones help in the dissemination of the pest, which is restricted because the Phadka is a poor flier. Thus, the pest is not migratory in habit and if it has appeared in a particular area, we may take it that it will make its appearance recurringly, unless the rainfall is much too scanty.

The gross area infested by the pest this year was about 1½ lakh acres in Ajmer-Merwara as against about one lakh in 1948. In Udaipur and Kishangarh States the gross infested area is estimated at 8 lakh acres. In Jodhpur State the menace is just raising its head and is confined to about 5,500 acres of grass *jhor* (land).

The first serious thought that this pest received was in 1947 in Ajmer-Merwara when various insecticides were tried, and BHC (5 per cent) in the earlier stages and 7 to 10 per cent in the late hopper and adult stages was found satisfactory. Thus poison dust was used on a large scale in 1948 and the scope of the campaign was further enlarged this year in view of the increase in the intensity of infestation and the extent of the area infested. About 27,000 acres of crop (mainly maize and the rest *jowar*, *bajra* and 200 acres of cotton in the early stages) were saved by dusting with about 118 tons of BHC. The infestation was so heavy that in the absence of these control operations, the crop would have been completely lost, both the grain and the fodder. Thus, in Ajmer-Merwara about 1,38,000 maunds of cereals were saved as also a valuable quantity of fodder. The latter also is of significant importance in this scarcity province. Most of the treated areas this year consists mainly of irrigated maize crop. This was given priority because there the yield was certain as compared with the ones in the *barani* (rain-fed) area. More could have been achieved and was necessary but the campaign was unfortunately handicapped by the shortage of poison which was held up in transit. In the Udaipur and Kishangarh states about 3,500 acres crop was saved. In these states, the control campaign was however, started late.

The Deccan wingless grasshopper (*Colemania sphenarioides*) is primarily a pest of maize, *jowar* and *bajra* and is peculiar to South India. Its main infestation is in Bombay province particularly in the districts of Belgaum, Dharwar and Bijapur. This is a hardier grasshopper than either of the two species of *Hieroglyphus* mentioned above. Therefore, a stronger BHC dust

is employed against it. The 7 per cent BHC dust is effective in the earlier stages and may even be effective in the adult stage, but in the latter stage the results are not so spectacular as those obtained by dusting 10 per cent gamma BHC (1 per cent gamma dust). This strength (10 per cent) has been extensively used this year. The infestation in these three districts of the Bombay province is estimated at 1,32,000 acres. As most of it is patchy and scattered the control campaign becomes complicated and not easy to man with trained personnel. On account of this difficulty and due to paucity of insecticides and dusting machines the crop area actually saved this year was 28,811 acres.

There is a great deal yet to achieve in the control of these three species of grasshoppers but it is encouraging to see the progress made from year to year as more poison and dusting equipment are becoming available. This year power dusting machines were given a trial in Belgaum, and it is to be expected that with their adoption next season, it will be possible to cover almost the entire infested area during the short effective period which the pests allow.

POTATO SPRAYING OPERATIONS IN WEST BENGAL IN 1949

(S. B. Chattopadhyaya, Assistant Mycologist, Department of Agriculture, West Bengal).

Large scale spraying of the potato crop was undertaken in the hills of Darjeeling District to control late blight (*Phytophthora infestans*), where it is always a serious problem. The devastating effect of the disease which often appears in epidemic form due to humid and cold climate of the potato growing tract is well known. The disease can only be controlled by systematic and routine spraying at regular intervals with fungicides.

The total acreage under potato crop in the district of Darjeeling is approximately 2,000 acres, of which about 1,100 acres are in Pulbazar P.S., 180 acres in Sokeapoolri P.S. and about 300 acres in Jore Bungalow P.S. Accordingly, centres were opened for spraying work at different localities. At first 600 acres were fixed as target but later on it was raised to 1,000 acres.

Chemicals used, dosage, number of applications, and interval between successive sprays

Three different fungicides, namely, Perenox, Dithane D-14, Dithane Z-78 were used in the spraying operations in the hills to find out the fungicides best suited for the purpose under the conditions prevailing in the different localities.

The dosages of the different fungicides used were as follows :—

Per 100 gallons of water

(1) Perenox ..	2½ lbs.	for 1st spray.
	4 lbs.	for 2nd and 3rd spray.
	4½ lbs.	for 4th and subsequent sprays.
(2) Dithane D-14 ..	⅓ gallon	for 1st spray.
Zinc sulphate ..	1 lb.	
Lime ..	⅓ lbs.	
Dithane D-14 ..	½ gallon	for 2nd spray.
Zinc sulphate ..	1½ lbs.	
Lime ..	½ lbs.	
Dithane D-14 ..	¾ gallon	for 3rd spray.
Zinc sulphate ..	2¼ lbs.	
Lime ..	¾ lbs.	
Dithane Z-78 ..	1 lb.	for 1st spray.
	1½ lbs.	for 2nd and 3rd spray.
	1¾-2 lbs.	for subsequent sprays.

The variations in dosage were necessary to avoid phytocidal damage. In the later stages higher doses were used so that with frequent rains and foggy weather, the spray residue may wash off gradually. Higher doses in later stages did not have an adverse effect on the plants. It was tentatively decided to apply 5 to 6 sprays at intervals of 10-12 days unless more frequent sprays were necessary. The number of sprays given was found quite sufficient.

The spraying operations commenced either in the last week of March, or the first week of April. It was generally felt that it would be better if spraying commenced 15 days earlier at least in lower elevations where cultivation is early.

As regards the efficacy of different chemicals, the following conclusions were reached.

Of the three fungicides tried, Dithanes (both D-14 and Z-78) were found to be superior to Perenox. Dithane D-14 seemed better than Dithane Z-78, although in preparing the spray it is rather cumbersome to mix the three ingredients. Perenox had one disadvantage. It damaged the maize crop which was intercultured with potatoes. It has to be used with a sticker, Albolineum, and was found to cause some phytocidal damage to leaves (crumpling) of the plant.

Dithane Z-78 and Dithane D-14 do not require any sticker. Dithane Z-78 has the further advantage that lesser quantities are required for obtaining the optimum strength of the fungicide (1½ lbs. as compared with 4 lbs. of (Perenox), the cost of transport is also reduced. In view of transport difficulties in the potato growing areas in Darjeeling district, this is an important consideration.

During the course of operation 55 Knapsack sprayers and 2 Silver Prince power sprayers were used. The Craven Hydraulux machine was also taken, but could not be used due to technical and operational difficulties. Of the Knapsack sprayers Four Oaks types were found to be the best and the most suited for the purpose due to following advantages :—

(*a*) The machine has to be carried on the back ; this practice very well suited to the practice of local people there.

(*b*) It does not require repeated filling up of spray liquid in comparison with other types having larger tank capacity (3 gallons working capacity). This is undoubtedly a great advantage in view of the fact that the source of water is in many cases far away from the fields.

(*c*) This machine is provided with a mechanism which provides discharge of the liquid at a high pressure ensuring mist and efficient spray covering both the surfaces of the leaves.

The Silver Prince, though light and portable, had a limited scope in the hills because of the following facts :—

(1) Absence of flat area where the machine can be easily operated.

(2) In the hills plants are generally not grown in rows and so the difficulty in taking the machine inside the field.

(3) Distance of water source and scarcity of water ; the operational cost becomes uneconomical.

Organisation of the Work

Stores.—The central store was at Sadar Seed Store, Darjeeling, from where the equipment was despatched from time to time as per requirement

to different centres. For matter of convenience a sub-store was maintained at Bijanbari for meeting the emergent needs of different centres of Pulbazar P.S. In each centre some store was maintained for day-to-day requirements.

Working plan.—In each centre one or two fieldmen (under Plant Protection Scheme) were posted to do the spraying work. The operations were carried out by labourers with the active help of *Mandals* concerned or other influential persons. The extension staff of the Directorate also lent a helping hand in this matter. The work was so arranged that they covered about 1/10 to 1/12th of the total area to be sprayed in a day. The number of labourers employed was one per machine besides 3 to 4 men for carrying water and preparing the solution. In quite a number of places, we were fortunate to get skilled labourers, who were capable of mending small repairs of machines. General supervision was under the charge of a Mycological Assistant.

Results

The sprayed potato plants were healthy and more or less free from the disease. In general there was an increase in longevity of 15-20 days and the plants had a very vigorous growth than the unsprayed areas. In general there was an increase in yield also than the unsprayed areas as assessed. From the information gathered it was conclusive that there was increased yield in the neighbourhood of at least 12-15 per cent. Volume of liquid required per acre was about 60-65 gallons. The strength of the chemical used was 4 lbs. per 100 gallons (Perenox) ; Dithane liquid ½ gallon, 1½ Zinc Sulphate, ½ lb. lime.

The optimum number of sprays required under normal condition is two. First spray during the time of first earthing-up operation and second spray just about a month later. Both the fungicides used gave identical results, but there was one advantage with Dithane D-14 (liquid) that it had a certain curative effect. Plants having slight attack with disease, if sprayed with Dithane liquid, the disease was checked and the plants had natural growth.

In this connection a few points should be mentioned on the comparative utility of different types of machines used for spraying. Three different types of power sprayers and a number of different types of knapsack sprayers were used.

Of the power sprayers, namely, Silver Prince, Cravan Hydraulux and John Bean type, Silver Prince had the following advantages subject to what has been stated above in para 11.

I. Light weight ; can be easily carried by one man, being fitted with wheel barrow arrangements.

II. Easy portability ; can be moved to any part of the field, can be carried from one place to another even in railway carriages without dismantling.

III. Easily operated ; because of the simple type of engine.

IV. Low consumption of petrol.

V. Suitability for ground crops.

Of the other two types, Cravan Hydraulux is better in one respect, in having no water reservoir attached to it ; with a number of drums of spray liquid previously arranged the engine can run for a considerable time without any cessation, and may work from one place.

But the most serious disadvantage with this type is the thickness of hose pipes. The hose pipes being heavy in weight, it requires 4 or 5 men to carry. The engine is also too heavy and bulky to be carried conveniently deep into the field. John Bean is fitted with a 50-gallon tank and naturally cannot be taken inside the field and sprayings can be done by placing the machine on a comparatively broad line. As this machine is fitted with a tank, so once the liquid is exhausted one has to wait for some time till the tank is filled up.

As regards the different types of knapsack sprayers 4 Oaks knapsack sprayers were decidedly the best and most suited for the purpose. Because the capacity of the sprayer is higher than other types, it does not require to be filled too frequently thus reducing the waste of time required for repeated filling. This type of sprayer is capable of working at a higher pressure, in the neighbourhood of 75 lbs. per square inch, and it thus ensures economic and efficient sprayings.

If once the pressure is raised before operation, it does not require any pumping till the entire liquid is discharged.

[Precise estimates of gains as a result of these spraying operations will be made after some crop cutting experiments have been carried out].

PLANT PROTECTION WORK IN COORG

(B. S. V. Rajan, Agricultural Officer, Coorg)

Approximately one-third of the total area of the province consists of evergreen forests. The plantations and other agricultural crops are found in the rest of the area. Among cereals, the paddy and ragi are grown extensively, while coffee, orange, arecanut, and cardamom form the plantation crops. Pests and diseases occur on all of them. The temperatures are equitable and throughout the year conditions are quite conducive for the persistant prevalence of pests and diseases. The coffee crop has always, for the past few years, been protected from diseases, especially leaf rust, but the plant protection practices have not reached the same standard in other crops. Though no exact data on the losses due to the prevalence of pests and diseases are available every farmer realises their importance and expresses great concern over the considerable damage caused.

The principal pests and diseases, against which methods of control are adopted, are briefly discussed below :—

Pests of paddy : Rice case worm (*Nymphula depunctalis* Guen.-Pyralidæ). —This pest occurs quite extensively in all paddy fields and in the early transplanted crop. Under certain weather conditions, particularly during continuous cloudy weather, it is found to cause severe damage. Drilled paddy suffers more due to this pest than transplanted paddy.

Leptispa (*Leptispa pygmaea* Baly—Chrysomelidæ).—Normally severe infestation of this pest on paddy crop is more in the case of drilled paddy but there are cases of bad infestation on transplanted crop also. The incidence is most severe in the nursery stages and early stages of crop growth. With the further growth of the crop, the severity of the infestation gets reduced. The pest passes two life-cycles on the crop itself and all stages of the pest are found during the growth period of the crop. When there is heavy infestation of the pest, fields are considerably damaged resulting in unevenness of the stand.

Paddy hairy caterpillar (*Nisaga simplex* Wlk.—Eupterotidæ).—This pest occurs especially in terraced fields at higher elevations and in higher rainfall areas. It is confined to three distinct zones in this province and does not occur in flats in the same zone. Since it is concentrated in these zones the damage caused is considerable and the farmers often go without a good harvest ; even straw gets damaged and is not available. From the preliminary investigations made on this pest it appears that it has only one brood during the growth period of the crop. The moths emerge during July and August, when there is heavy monsoon, and lay light pink coloured eggs in streaks on paddy seedlings and other weeds on the bunds. The length of the streaks varies from three-fourths of an inch to one and half inches. The eggs change their colour as they mature and are black at the time of hatching. The egg-stage is about eight to ten days. The young caterpillars start feeding on the leaves, and when they are about one inch in length, they start migrating in groups. Ordinarily each clump would contain anything from twenty five to hundred young caterpillars voraciously feeding on the crop. The full-sized

caterpillars are about two to two and a half inches in length and at this stage the crop is in the flowering period. The ears are cut off by mature caterpillars aggravating the loss to the ryots. They pupate in the soil along the bunds, only to emerge when the next monsoon sets in. This pest is known in this province from a long time and the farmers hand-pick them. Due to the persistant prevalence of this pest some lands have remained fallow. Approximately 1,000 acres are infested by this pest.

Paddy stem borer (*Schoenobius incertellus* Wlk.—Pyralidæ).—Sporadic occurrence of this pest is seen in some places confined to more or less the western villages. The paddy fields on the river banks and the second crop of paddy in the western villages suffer more from this pest.

Where there is severe infestation of the pest most of the ears are white and chaffy, thus reducing the yield of grain considerably. About 1,000 acres are infested by this pest of which the major portion is in the western villages bordering South Kanara.

Rice bug (*Leptocorisa acuta* Thubg.—Coreidæ).—This pest is found throughout Coorg but not in such large numbers as to cause any noticeable damage except in the villages bordering South Kanara where the infestation is profound and severe. The severity is more in the second crop of paddy in these areas. About 2,000 acres are damaged by this pest.

Paddy grasshoppers (*Hieroglyphus banian* Fab.—Acridiidæ and *Oxya velox* Fab.—Acridiidæ).—These are confined to western villages bordering South Kanara.

Diseases: PADDY BLAST (*Piricularia oryzae* Carvara and *Helminthosporium oryzae* Breda de Haan).—This disease is found in nurseries and later on spreads to the main fields. This is prevalent in dry nurseries mostly.

Control Measures.—The already known method of control as applicable to leaf eating caterpillars, viz., lead arsenate spraying, did not prove useful in controlling some of the above mentioned pests. Varying strengths of lead arsenate were sprayed against *Leptispa* and hairy caterpillar attack. The success was only 5 to 10 per cent in spite of concentrated sprayings

Guesarol and Hexyclan were tried against all the pests of paddy, with the exception of paddy stem-borer (*Schoenobius incertellus* Wlk.) with remarkable success. The success against paddy hairy caterpillars with Guesarol was striking and gave about 90 per cent mortality. The caterpillars were dead in about fifteen minutes after spraying. Hexyclan was similarly very successful against *Leptispa*.

Kerosine oil treatment and dusting with Hexyclan against rice case worm were found very effective. Grasshoppers and rice-bugs readily succumbed to both Hexyclan and Guesarol treatments.

Light traps, being the only known measure for controlling paddy-stem-borer, were tried in areas showing severe attack of this pest. Large number of adult moths were collected in these places and there was a marked reduction in the severity of the pest as compared with the untreated fields. Besides this, topping of seedlings before transplanting was also done.

Light traps were tried in areas affected by the hairy-caterpillars. Moths were collected in hundreds during July and August and destroyed.

Nurseries showing signs of *Piricularia* or *Helminthosporium* attack were sprayed with Bordeaux mixture with success. Since seed treating drums could not be procured early, seed treating has been taken on hand only recently. Paddy seed was treated with Agrosan GN against the seed-borne diseases.

Orange Pests : Orange stem borer and orange top shoot borer. These are major insect pests affecting orange trees in Coorg. Wherever the orange stem borer occurs it is found to cause considerable damage to the estates. The top shoot borer occurs commonly in most of the estates and is a constant worry to the orchard owners.

Diseases : Fruit rot and leaf fall. Whenever there is a prolonged rainy or humid weather, this disease occurs in an epidemic form. Most of the estates are infected by this disease causing in some places severe loss in yield. The disease is difficult to control when it occurs in a severe form. Only preventive measure is spraying with Bordeaux mixture before and after the monsoon ; this practice has been very effective.

Gummosis (*Phytophthora palmivora* Butler) : This disease is gradually spreading in Coorg. In the early stages of the disease, only splitting of the bark is noticed but later, death of the bark and the wood underlying it is seen spreading towards the roots and ultimately ringing the stem causing death of the trees.

Powdery Mildew (*Oidium* sp).—This disease generally appears twice in a year. Once in May-June and again in September-November. In some zones the incidence of this disease is very severe. The disease is prevalent through out Coorg.

Control Measures.— Spraying with 1 percent Bordeaux mixture against fruit rot and leaf fall, dusting of sulphur against powdery mildew have been found to be the best methods of control and are becoming regular orchard practices. Two sprays of Bordeaux mixture, one before and the other after the monsoon are generally done. Marked difference between sprayed and unsprayed areas can be easily noticed. Gummosis is treated effectively with Bordeaux paste. Many trees have been saved from this disease by applying this paste. Dusting of sulphur against powdery mildew gives more than 90 per cent control.

Carbon-disulphide is very useful in controlling borers. The chemical is sprayed into the tunnels of the borers and then plugged. Both in laboratory and field trials this treatment was very successful.

About 3,830 acres were sprayed with Bordeaux mixture and treated with Bordeaux paste against fruit rot, leaf-fall and gummosis in 1948. 563 acres were treated against powdery mildew with sulphur and 150 acres against orange borer in the year 1948-49 by the Plant Protection staff.

Arecanut : Koleroga (*Phytophthora arecae* (Colem.) Pethyb.)—This disease commonly occurs in the western villages bordering South Kanara. This is a heavy rainfall area and as such this disease is very prevalent here.

Control measures.—One per cent Bordeaux mixture spray is the usual practice here and almost every grower is aware of its usefulness.

Two or three sprayings are given at intervals of about a month during the breaks in monsoon. The Departmental staff assisted the growers in getting their gardens sprayed.

Coffee Pests : Coffee Borer (*Xylotrechus quadripes* Chevr. Cerambycidæ). —Coffee borer is found only in *Arabica* plantations. *Robusta* plantations are free from this pest. The grubs feed inside the wood of the stem forming tunnels and pupate in the stem. Borer removal is vigilently supervised by the Departmental staff in all coffee estates. The planters are expected to keep their estates free from these pests.

Coffee Diseases : Rust (*Hemileia vastatrix* Berk.)—This disease occurs in *Arabica* plantations only. Yellow spots of the disease are seen on the under-surface of the leaves.

Spraying of 0·5 per cent Bordeaux mixture is a widely established practice in the coffee estates against the rust on coffee. The spraying work is under taken by the planters themselves. However, a mobile unit has been organised to assist the small planters who own less than 25 acres to get their estates sprayed.

Leaf rot—*Phytophthora* sp.—This disease is seen in almost all the estates and spraying with 0·5 per cent Bordeaux mixture has given good results and has become a common practice in most of the gardens in controlling the disease.

Cardamom Disease : A yet unidentified cardamom disease causing leaf spots in the nurseries was observed and spraying with one per cent Bordeaux mixture has been found to reduce the extent of damage considerably.

The following are the achievements of Plant Protection Scheme for the year ending 31st March, 1949.

Crop	Pest or disease	Area sprayed/dusted	Estimated increase in yield
Orange	Fruit rot & Leaf-fall,	3,830 acres	Rs. 3,83,000/-
	Gummosis, Powdery Mildew,	550 acres	Rs. 11,260/-
	Borer	150 acres	Rs. 1,500/-
Paddy	General fungoid diseases	100 tons of seed paddy treated with Agrosan GN	(About Rs. 500 in the year 1949-50)
	Hairy caterpillar	493 acres	82 tons
	Rice case worm	490 acres	41 tons
	Leptispa pest	5 acres	1 ton
	Rice bug	15 acres	7½ tons
	Piricularia disease	30 acres	5 tons
	Ephelis disease	10 acres	

In addition to the above, about 1,000 acres of coffee estates were sprayed under the mobile unit scheme.

RAT MENACE TO PADDY AND OTHER CROPS: CONTROL BY POISON BAITING

(V. Tirumalarao, B.Sc. (Ag.), Crop and Plant Protection Officer (Entomology) Bapatla, Madras)

During May 1949 paddy nurseries, vegetable crops and sugarcane in the Krishna and Guntur districts were seriously damaged by field rats. The damage to field crops had been on the increase for the last few years and the cultivators ascribed the increase in rat population to the increase of area under the second crop of paddy, grams, green manure crop like ' Pillipersara', (*Phaseolus trilobus*) and vegetables and to the indiscriminate destruction of snakes in the country.

The most common species found damaging crops are *Gunomys kok*, *Ratus ratus-wrougtani*, *Ratus ratus-rufescens* and *Bandicota* sp. These rats attack also gram crop after paddy, ragi, coconut seedlings, tapioca roots, *Colocasia*, underground stem of banana, lucerne, pumpkin and even roots of tea. They are not bound by any elevation and occur from sea level right upto an elevation of 8,000 ft.

Mode of damage.—The rats break up soil and pick out the germinating seeds and even after germination, seedlings are uprooted and taken to their burrows. As a result of this the seed beds are left bare every morning with a number of patches dug up. Vegetable crops are completely and mercilessly cut and mutilated and sometimes carried into their burrows. In the case of sugarcane, the clumps are completely dug out and destroyed.

Local methods for controlling rats.—In the past the common practice with the ryots was to employ rat-catchers who by digging up the bunds caught rats and killed them. The rat-catcher was paid one anna per rat caught. Thus a good amount was being spent on this method which due to large population of rats was not effective. Moreover the ryots had to employ additional labour to level up the dug up burrows. Lastly, hand catching of rats is a very slow process and by the time a rat-catcher clears one block and goes to the next there may be mass migration of rats into areas already cleared.

Poison Baits.—Trials with zinc phosphide, barium carbonate and 'Antu' were made in 1949. Zinc phosphide gave comparatively quick kill and rats were particularly attracted to this poison. The effective dose was 5 per cent with cooked rice as the carrier. Rats died 40 minutes after eating the bait. Barium carbonate (20 per cent) took 3 hours to kill the rats. The rats did not take readily 10 per cent white arsenic bait but on eating it, refused to take anything and died within 3 hours. 'Antu' took nearly 30 hours to kill rats. With the change in the bases from rice to chopped guava, zinc phosphide was also found effective against squirrels (*Funambulus palmarum*). From one acre (having nearly 85 burrows) 75-100 rats were found dead and about 7 bandicoots were reported to be dead when bait was put in a house. During field trials, zinc phosphide as posion against rat became fairly popular among ryots.

Rats in Vuyyur area and in Guntur.—With the experience gained with the different baits, a regular campaign was organised first in the Krishna district and next in Guntur district. Since the ryots were already aware of the raticidal efficacy of zinc phosphide, there was a great demand for the poison. The poison was distributed in small packets of 4 tolas on ration basis so as to effect equitable distribution. During the course of 6 weeks, 30,000 packets (3,000 lbs.) were distributed. Fresh supplies of zinc phosphide to the tune of 5 tons were secured by the Department. Most of this quantity was exhausted immediately on receipt in the depots. As a result of use of zinc phosphide the rat population was reduced from 5 to 1 per cent. For the straggler the change of base to boiled green or black gram with the addition of fried onion (fried in oil) or chopped dry fish was recommended.

The obvious result of this campaign was that Krishna and Guntur districts which are supposed to be the granaries of Madras Presidency in South India were saved from the shortage of food supply in paddy production over an area of 30,000 acres of seed beds which otherwise would have been destroyed by rats.

BEHAVIOUR OF DIFFERENT VARIETIES OF WHEAT AGAINST RUSTS DURING 1947-48

(Dte. P. P. Q. & S., New Delhi)

The reaction of the several varieties of wheat grown in the different provinces and states of India against rusts during the year 1947-48, was as follows :—

East Punjab.—The following varieties of wheat were sown in the various districts of East Punjab.

Local, 8 A, C.217, C.228, C.229, C.250, C.253, C.518, C.591 and 9 D.

None of the varieties were uniformly susceptible or resistant to the three rusts in the various districts of East Punjab. It was, however, observed that C.228, C.250, C.229 were usually resistant to yellow rust while C.518, C.591 and 9 D were susceptible to it ; C.591 particularly in irrigated areas and 9 D in *Barani* areas. The variety, C.250 which seemed resistant to yellow rust was found highly susceptible to black rust.

United Provinces.—In U. P. the following varieties of wheat were grown : Local, I.P.4, I.P.12, I.P.52, I.P.125, I.P.165, C.13, C.46, Pb.228, Pb. 409, Pb. 518, N. P. 591, N. P. 710, N. P. 715, N.P. 733, N. P. 761, N. P. 775.

The local varieties proved most susceptible, but the varieties I. P. 852, I.P. 125, I.P.165, C. 13, C.46, Pb.591 and Pb.228 were also found susceptible. It is interesting to note that the variety N.P. 52 which was considered resistant proved to be highly susceptible in Gorakhpur district. I.P. 4 was found to be resistant to the three rusts.

Bihar.—In Bihar the varieties local '*dudhia*' Red Wheat, and I.P. 52 were sown in the province. The local '*dudhia*' was susceptible to the three rusts. I.P.52 and Red Wheat were resistant in certain regions, but the same was not true in other localities. C.9 and I.P.52 were found to be susceptible to brown and yellow rusts in Ranchi area.

Bombay.—In Bombay the local varieties, Vijay, Red, Mondhya, Gulab, I.P.4, Niphad 4, and Khapli were sown.

Pusa 4, Niphad 4 and Khapli were less susceptible to black and brown rusts than others.

Baroda.—In Baroda Local Wajia, Red Kantha, Bansi, I.P.4, I.P.52, Cawnpore 13, and N.81 were sown. Wajia was susceptible to brown rust and Red Kantha and Bansi to black. I.P.4 was resistant to black rust and Cawnpore 13 and I.P.52 to brown rust.

West Bengal.—In West Bengal the varieties Local Dudhia, Gangajali, Jamal-Kheri P.4, P.12 and P.52 were sown.

The Local, Gangajali, Jamali and Kheri were susceptible to yellow and brown rusts. P.4 and P.12 were susceptible to brown in the Kalimpong area ; P-52 was found to be comparatively resistant in that area.

C.P. & Berar.—In C.P. and Berar the varieties Howrah, Local, Khapli Kathia, Bansipalli, Red Pissi, A.115 and C.591 were sown. I.P.4 and Bansipalli were generally resistant to black and brown rusts, the variety I.P..52, being resistant in certain areas but not in others. In Nagpur it was susceptible to both black and brown rusts. C. 591 was only moderately susceptible to black rust.

Local, Red Pissi, Kathia and Howrah Local were susceptible to all the rusts.

Madras.—Only " Samba" (*Triticum dicoccum*) is cultivated in the province. Small patches of N.P.111 were grown in the Nilgiris, but was found to be highly susceptible to black rust. The *T. dicoccum* (or Samba) wheat grown in the Nilgiris and plains was susceptible to brown and yellow rusts but exhibited considerable field resistance to black rust.

Mysore.—Triticium dicoccum, and T. monococcum wheats were sown in the Mysore State. None of the varieties proved resistant.

It seems apparent from the above that the varieties I.P.4 & I.P.52 were resistant in a majority of the areas; though that was not uniformly so in all the places, *e.g.*, I.P.52 proved susceptible in certain localities in U.P. and Bihar. C.591 which is rather popular variety in northern India proved highly susceptible to yellow rust in Punjab and U.P. Apart from this no generalized conclusion can be drawn from the above.

USE OF DDT AND BENZENE HEXACHLORIDE AGAINST STORED GRAIN PESTS

(Dte. P. P. Q. & S., New Delhi)

The problem of controlling insects in stored grain by the use of chemicals has been a difficult one in so far as the treated grain has to be consumed by human beings and domestic animals. Before recommending any insecticide against store insects it has to be ensured that it does not affect or contaminate the grain in any way, thereby endangering the health of the consumer. In view of these difficulties most of the stomach and contact poisons cannot be used for protecting stored grain. The use of fumigants had so far been the only satisfactory method for disinfestation of grain and stores, but fumigation does not make the grain immune from future infestation. Of late synthetic insecticides, *e.g.*, DDT, Benzene hexachloride, etc. have come into use not only for pests of the field crops but also of the grain during storage.

Among outstanding synthetic insecticides, Dichlorodiphenyl-trichloroethane (DDT) and Benzene hexachloride (BHC), the former having been most thoroughly investigated and used extensively against insects of agricultural, medical and veterinary importance. The purpose of this note is to describe methods in which these compounds are used against insects infesting grain and to indicate the limitations and toxic hazard in the use of these insecticides.

Admixture with grain.—In the Plant Protection Advisory Leaflet No. 1, issued in August, 1947, by the Directorate of Plant Protection, Quarantine and Storage, the use of DDT and BHC, (the latter under the trade name of Gammexane) for the protection of stored grain from damage by insects was outlined. On the basis of critical tests carried out with these insecticides it was recommended that one part of either of these insecticides when mixed with 10,000 parts of the grain will afford complete protection against all insect pests except *khapra* larvae. This procedure is particularly adaptable in small scale storage in farm godowns and *mandis*, though there may be some difficulties in its adoption in large godowns. This treatment is particularly useful and free from any risk in the case of grain meant for seed purposes. In some parts of the world DDT is being mixed with grain meant for human consumption. Report VIII on " International Congress on Entomology and visits to laboratories in Denmark, Holland and Belgium " August, 1948, by Herford and Parkin, says " That 5 per cent DDT powder has been commonly mixed with grain with no known subsequent injurious effect, but in view of the caution which is being urged in other countries the application of DDT to foodstuffs, the direct admixture of DDT dust to grain is now avoided, if possible. We were informed that a special preparation is being patented in Denmark consisting of 3·5 per cent DDT and about 1 per cent pyrethrum, which is intended to be used as a dust for mixing with grain or for spreading on the floor of infested granaries before introduction of clean grain ".

Whether grain treated with these insecticides can be consumed by humans without running the risk of toxic hazard, is a question of considerable

controversy. Dr. Lehman carried out investigations as Head of the Pharmacology, Food and Drug Administration, U.S.A., and recently recommended that the DDT tolerance should be reduced from 7 ppm to 1 ppm in all foodstuffs meant for human consumption. Comparatively little work has been done on BHC but it may be emphasized that both DDT and BHC are equally toxic to insects and to humans when ingested in large doses. Pending further investigation, admixture with foodgrains of any of them cannot be recommended.

Surface Dusting of Bags.—External dusting of bags with BHC or DDT is recommended by some workers for preventing cross infestation of grain stocks. The dosage recommended is 6-8 oz. per 100 sq. ft. of exposed surface. The extraneous dust constantly covering the insecticidal layer will materially reduce the activity of the insecticidal layer soon after the operation. Hence, the insecticidal layer cannot remain as active as it should be. Furthermore, insects inside the bags are admittedly not affected by the insecticide and they continue breeding uninterrupted. It is, therefore, not possible to expect results commensurate with the cost of the insecticide. This is particularly true of BHC which has to be used most frequently as its residual effect is not so lasting.

Treatment of Empty Stores.—In the case of empty stores, insects usually lurk in cracks and crevices and behind broken plaster on walls, floors etc. Although the filling in of these cracks and crevices goes a long way in killing a large proportion of insects, but their mortality is never complete. This is because the grating is not done deep into cracks with the result that insects farther away from the plaster remain unaffected and make their way through the plaster and reach the fresh stocks as soon as they arrive. It is, therefore, essential that any one of the following treatments should be given before carrying out the necessary repairs :—

(*a*) *Dust Treatment*

Empty stores can be disinfested by dusting the walls, ceilings and floors with 5 per cent BHC or DDT at 6-8 oz. of the insecticide per 100 sq. ft. of the exposed area. As far as possible the dust should be evenly distributed over the walls in order to get satisfactory results. Dust should be forced deep into cracks and crevices. It may be necessary to repeat this treatment every two or three months in the case of DDT and every month in the case of BHC, because of the better residual effect of the former. The treatment may have to be repeated often if the conditions of the store so warrant.

(*b*) *Spray Treatment*

Spray treatment of empty stores gives more satisfactory results than dusting as there is little loss of the insecticide. It is, therefore, more economical. The residual effect of treatment lasts for about a couple of months in the case of DDT and less in the case of BHC.

Spraying walls with 50 per cent DDT wettable powder diluted in water at the rate of 1 lb. into 5 gallons (1 per cent DDT concentration) and applied at the rate of a gallon per 1,500 sq. ft. will bring about very satisfactory disinfestation of the store.

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Spraying with 5 per cent DDT mixed with Pyrethrum (0·05 per cent Pyrethrin content) is also useful for disinfestation of empty store.

Spraying of 2 per cent DDT dissolved in white oil has also been found to give satisfactory results when applied in fine spray on the walls.

(c) Smoke Treatment

Dispersal of insecticide through smokes in a given atmosphere is one of the latest methods in the technique of insect control. So far as the stores are concerned, this treatment has its limitation. Smoke deposition in the store is not uniform—the vertical surface (walls) receiving very much less than the horizontal surface (floors and ceilings etc.). The penetration of the smoke into cracks and crevices is not deep so as to reach all the insects lodging therein. Insects which usually crawl over the walls more than on the floors will pick up correspondingly less insecticide than those which will be crawling on the floor where the number is usually very small. Moreover the smoke layer on floor cannot be as effective even for sometime because of its being covered over by dust and its continually being broken by the feet of the workers when in the stores. Above all, this treatment can successfully be carried out only if the store can be made reasonably air-tight. The residual effect under practical conditions of storage cannot, therefore, be expected to be long.

DDT and BHC mixed with certain igniting substances which when lighted help in producing smoke fumes which spread out in an enclosed space and get deposited on the surface walls and ceiling. The insecticide and igniting substances are filled in containers of different sizes (1-16 oz.) sufficient to treat surface varying from 1,000 to 10,000 cu. ft. of empty space. These containers are marketed under different names by different firms in India.

Equipment.—For small scale operations single or double bellow dusters or knapsack dusters will be useful. Rotary or power dusters will be more convenient for use in large rooms.

For sprays, stirrup pump fitted with rubber hose and specially convertible single or double nozzle or pressure sprayers are the most suitable appliances.

Precautions.—(*i*) The operator should be equipped with canister type respirators. In small rooms, however, covering of mouth and nostrils with a piece of cloth may suffice. The operators should not keep their arms and feet exposed.

(*ii*) The operators as far as possible should not stay long in the atmosphere with insecticides dust or spray mist. He should come out as soon as he feels any discomfort. It would be better to have a set of workers who could alternately work for half an hour at a time.

CROP DISEASES IN ASSAM

(Dte. P. P. Q. & S., New Delhi)

The following items of interest are from the Annual Report of the Department of Agriculture, Assam, for the year ending March 31, 1947 (issued 1949).

In the Surma Valley, foot-rot and leaf-spot of palm were effectively controlled by spraying the diseased plants with Bordeaux mixture. Of a total of 669 plants, only 14, or 2 per cent succumbed to the disease. A 1 : 1 : 50 mixture was applied six times between May and October at the rate of 50 gallons of liquid to a ridge of 100 ft. The approximate cost per acre was Rs. 63/12/-. When the concentration was doubled the percentage of death was reduced to 1·1 but the cost increased to Rs. 107/8/-.

Anthracnose of citrus trees affected the plantations in the Machipore area in an epidemic form. Plants manured with cow-dung compost and ammonium sulphate and thoroughly sprayed with 2 : 2 : 50 Bordeaux mixture gave remarkably good crop of fruit, new and disease-free foliage and very healthy growth.

In some parts of Assam a disease of bananas, the growers call it ' phola ', was found to be prevalent. The characteristic symptom was the emergence of a number of small sickly suckers from a worn-out starved corm. The suckers were stunted and crowded. The Mycologist believed that the disease was physiological and was able to control it to a certain extent when the corms were taken proper care of by manuring and earthing.

Different seed treatments were tried against *Helminthosporium* disease of rice and it was found that the incidence of the disease after seed treatment was 8·4 with hot water, 10·2 with Ceresan and 10·5 with Agrosan, controls being 20 per cent.

Cotton in Assam suffered from *Cercospora gossypina* Cke. *Glomerella gossypii* (Southw.) Edgerton and *Rhizoctonia* sp. The first two diseases appear to affect the long staple type of cotton more seriously than the short staple ones.

Spraying the groundnut crop with Perenox reduced the intensity of 'tikka' disease caused by *Cercospora personata* (Berk. and Curt.) Ell. and Everh.

Both early and late blights of potatoes appeared to be very serious in the lower Assam valley, causing enormous loss to the crop. In some particular plots late blight appeared in such a virulent form that the crop was completely ruined within 4 or 5 days.

EFFECT OF TREATMENT OF PADDY SEEDS IN WEST BENGAL

(S. B. Chattopadhyaya, Assistant Mycologist, Department of Agriculture, West Bengal)

A few varieties of paddy seeds belonging to the farmers were treated with Agrosan GN in 1948 in some of the villages in Hooghly district. The treated seeds in most cases were sown in the first to second week of June. After the seedlings had come up and made some growth observations were taken to ascertain the effect of this seed treatment. Since the observations were taken from cultivators' plots, which are different from scientifically designed ones, attention was paid to the following aspects only, namely, (1) time taken for the emergence of the seedlings, (2) nature of general stand, (3) condition of the seedlings so far as growth is concerned and (4) extent of seedling infection, if any. Suitable control plots (sown with untreated seeds) were maintained to compare the results of seed treatment.

Effect on the Emergence of the Seedlings

The emergence of the seedlings in all cases (*i.e.* treated and untreated) took place within 5-7 days after sowing in upland seed-beds. As the seedlings came up at about the same time in both the cases, it could be assumed that the treatment of seeds with Agrosan GN did not have delaying effect on their germination.

Effect on General Stand

To get a precise estimate of the conditions of the stand, the following procedure was adopted. From both treated and control plots, the number of seedlings per square foot area, selected at random, was counted. The number of unit areas selected depended on the size of the plots ; usually 10 readings were taken of plots of about 0·1 to 0·15 acres, which are usually the average sizes of seed-bed plots. For better comparison the control plots were so chosen that they were in close proximity to those sown with treated seeds. Though a number of varieties of paddy seeds were treated, attention was particularly confined to *Nagra, Jhingasail, Kalan Kati*, and two *Auses*, (black and red) because they comprised more popular varieties in their respective localities. The data are presented in Table I.

It is evident from these figures that treatment of paddy seeds with Agrosan GN resulted in an increase in stand as compared with the control. This is probably due to the fact that when seeds are treated with Agrosan GN, it not only kills the pathogenic spores carried on the surface of the grains but leaves a protective layer of the fungicide on the seed coat to resist secondary infection from without.

Effect on the Growth of Seedlings

Seedlings from treated seeds appeared more healthy, made better and quicker growth, and looked more green than those in the control plots. Even the cultivators, who are highly critical about chemical seed treatments did not fail to note the highly beneficial effect on the seedling stand.

Effect on Seedling Diseases among the Seedlings

In general, plots sown with treated seeds showed a very small percentage of seedlings attacked with any of the common diseases of seed-beds, viz. *Helminthosporium oryzae*, *Curvularia lunata*, and *Trichoconis padwickii*. It was also observed that the seedlings with primary infection were practically absent but in many cases secondary infection of younger leaves was noticed. Such infection was limited to the later flush of younger leaves only. This suggested that in the beginning the seedlings were free from the attack of any pathogen, but later on they became infected from secondary sources.

TABLE I

Influence of seed treatment on stand of rice seedlings

Paddy variety	Treatment	Average number of plants per square foot area	Average percent increase in stand compared with control	Remarks
Jhingasail	Agrosan GN	207	40	Condition of seedlings very good, practically no primary infection, some secondary infection prosent
Jhingasail	Control	148	..	Both primary and secondary infections present
Nagra	Agrosan GN	206	40	No primary infection, a few scattered secondary infection on leaves
Nagra	Control	133	..	Both primary and secondary infections present
Aus (black)	Agrosan GN	147	140	Practically free from both primary and secondary infections
Aus (black)	Control	61	..	Both primary and secondary infections present
Aus (red)	Agrosan GN	170	29	Almost no primary or secondary infection
Aus (red)	Control	132	..	Heavy primary and secondary infections; 50 per cent of the seedlings infected
Kalam Kati	Agrosan GN	223	33	Luxuriant growth and practically free from infection
Kalam Kati	Control	171	..	Rather poor growth; both primary and secondary infections present

DISEASES OF CUMIN AND FENNEL

(Dte. P. P. Q. & S., New Delhi)

Powdery Mildew of Cumin (*Erysiphe polygoni* DC.)

Distribution and Damage.—Powdery mildew is a common disease of cumin and occurs in north Gujrat (Bombay), Ajmer-Merwara and certain parts of Rajasthan and Madras. The disease normally causes some loss but in certain years it assumes an epidemic form resulting in complete failure of the crop. If the disease appears at the time of flowering, the loss in yield may be about 50 per cent. If, however, the mildew appears about the time of seed formation, the damage may not exceed 10—15 per cent.

Symptoms.—In Bombay Presidency, the disease generally appears during the early part of January, while in Ajmer-Merwara, mildew appears about the first week of February. An early symptom of the disease is the formation of greyish or white specks on the lower leaves. These specks rapidly enlarge and coalesce to cover the entire leaf surface with the mycelium and powdery mass of spores. The mildew spreads from leaves to stems which are also covered with a thin white growth.

The disease also attacks flowers and fruit. In moist warm weather, mildew covers the blossoms so completely that the fruit does not mature, resulting in a heavy reduction in yield. Under these conditions powdery mildew spreads with great rapidity and the infected fields present a characteristic appearance and look as if dusted with fine white flour. If, however, the weather is hot and dry, mildew does not spread to blossoms and the fruits develop normally.

Effect of Climate on Mildew.—Temperature is the most important factor influencing the growth of powdery mildew ; it develops most rapidly at temperatures between 80° and 90°F. Temperatures below 80°F. are unfavourable for its development.

Precipitation is not necessary for the development of mildew though it helps in starting initial infection. Such atmospheric humidities prevail at the growing period. Irrigation water, used in supplying the needs of the growing crop, increases atmospheric humidity, which favours the development of mildew.

Control.—Powdery mildew of cumin has been effectively controlled in Bombay by sulphur dusting. Total elimination of the disease was obtained in dusted plots by one application of sulphur made about the time of flowering. The quantity of dust required per acre for one application is about 25 lbs. The cost of one application may be about Rs. 3/8/- per acre.

If necessary, a second dusting may be applied about the time of seed formation. The quantity of sulphur required for the second dusting should, however, be about half of that used during the first dusting. If the first application is made thoroughly and at the proper time, the second dusting may not be needed.

Dusting of about 40 acres of cumin crop for controlling mildew was carried out during the last season in different villages of Ajmer-Merwara with successful results. It is intended to treat much larger areas of the crop next season.

Blight of Cumin (*Alternaria burnsii* Uppal, Patel & Kamat)

Distribution and Damage.—Cumin blight occurs sporadically in north Gujrat (Bombay), Madhya Bharat and certain parts of Rajasthan. The disease appears to be considerably influenced by humid conditions as the affected plants are commonly found along water channels in a field or in situations with dense shade. Under favourable weather conditions, therefore, the blight may assume serious proportions.

Symptoms.—In early stages of attack, the affected plants show minute whitish necrotic areas which turn purple with age and later become brown and finally black. All aerial parts of the plant are involved, the extent of damage depending upon the time of appearance of the disease and the stage of maturity of the crop. The disease ultimately kills the affected parts, particularly the succulent leaves and blossoms. It is named blight because of the complete death of the tissues of the whole or part of the plant affected.

Blight appears about the middle of January when the crop is about 2 months old. If the disease appears at flowering time the whole crop may be destroyed provided wet weather prevails. Under such conditions affected plants rapidly wither and collapse into pulpy masses. Infection is largely confined to the tips of the leaves but rapidly extends down to the stem during wet weather. In cases of severe attack, affected plants bear no seeds, but if some seeds are produced, they are usually shrivelled, dark coloured, light in weight and poor in germination.

Control.—The fungus is able to oversummer in plant residues in the field. It is probable that infected seed also plays an important part in the perennation of the fungus and in initiating primary infection.

Selection of good seed and the application of a protective spray-cover with Bordeaux mixture, Perenox, etc., to the young plants in order to avoid secondary infection, should provide a satisfactory control of the disease.

Wilt of Cumin.—During February-March 1949 a wilt disease of cumin was found to be causing considerable damage to the crop in Ajmer-Merwara as well as in Jaipur and Alwar States of Rajasthan. This disease, which commences from the seedling stage and continues till maturity of the crop, is characterised by a yellowing and later drying of the plants. At Kekri (Ajmer-Merwara) the general incidence of cumin wilt ranged from 25-40 per cent while in certain fields as many as 75 per cent of the plants were found killed due to the disease. The plants were affected in patches and the diseased ones could be easily spotted from a distance. On examination of the roots of the affected plants, pink coloured sporodochia of *Fusarium* sp. were observed on several of them. Section of the diseased roots also revealed the presence of septate hyphae inside the xylem vessels and wood parenchyma. The causal agent may be a *Fusarium* sp. As the disease is of a

serious nature and of wide-spread occurrence, it deserves immediate investigation. It may be mentioned that the wilt of cumin due to *Fusarium* has not probably so far been recorded elsewhere. In Bulgaria (1936) *Fusarium* sp. was isolated from cumin plants suffering from root-rot but the disease could not be reproduced in inoculation tests. In Madras (1935-36) the fungus *Macrophomina phaseoli* was isolated for the first time from wilted plants of cumin.

Blight of Fennel (*Cercospora foeniculi* P. Magn.)

Blight is a serious disease of fennel (sonf) and has been reported to occur in Kashmir, Bihar, Punjab and Ajmer-Merwara. In those years when the disease assumes an epidemic form, the crop suffers appreciable damage. The grains are either not formed or, if produced, are very much shrivelled and blackened. The disease attacks all the parts of the plant, namely, stems, peduncles and leaves. In severe cases flowers are also affected. The disease appears in the form of small necrotic streaks which later turn dark brown. Later these lesions are elongated and are spread over the entire plant. Under favourable conditions, whitish, fluffy growths consisting of the fructifications of the fungus appear on the dark areas.

During March 1948, fennel blight was observed in a very severe form at Kekri (Ajmer-Merwara). The entire crop appeared as if burnt. When the same field was inspected in March 1949, the crop was found to be completely free from infection. In other localities of Ajmer-Merwara also, the disease was absent. Fennel is practically a full year crop (August-April) and the same field may give 4 to 5 crops successively without fresh seeding. The seeds which fall on the ground during harvest germinate and give rise to the new crop next season. The blight disease had occurred during the past two or three years in an epidemic form. The absence of the disease in 1949 is believed to be due to the prevalence of comparatively dry weather conditions throughout the period of growth of this crop. Hardly any work on this disease has been carried out in India and it is important to investigate the epidemiology and life history of the casual fungus in order to be able to recommend necessary control measures.

INTERNATIONAL CROP PROTECTION CONGRESS, LONDON, 1949

(Dte. P. P. Q. & S., New Delhi)

The International Congress of Crop Protection was held in London between July 20 and July 30. It was the second of its kind, the first having been held in 1946 at Louvain in Belgium.

Held under the Presidentship of the Rt. Hon. Viscount Bledisole, the Congress was attended by 600 delegates from 30 different countries, the meeting for the most part taking place in the Imperial College of Science and Technology, South Kensington.

The Congress was organised in six sections each with its own President of Honour and Chairman, the subjects dealt with by each being as follows :

Section	President of Honour	Chairman
I. Insecticides	Prof. Sir Ian Heilborn, D. S. O., F. R. S.	C. T. Gimmingham, O. B. E.
II. Fungicides	Prof. H. Osvald (Sweden) ..	Prof. W. Brown, F. ..
III. Plant Growth Regulators ..	Prof. W. H. Schopfer (Switzerland)	M. A. H. Tincker
IV. Toxicology of Crop Protection Substances	Dr. R. Poutiers (France) ..	Prof. G. Cameon. F. R. S.
V. Methods of Application ..	Dr. J. G. Horsfall (U. S. A.)	J. E. Hardy
VI. Analytical Methods and Standardisation	Prof. R. Mayne (Belgium) ..	H. Martin

In all 94 papers covering subjects under the above heads were presented to and discussed at the meetings. In addition, lectures to the Fuel Congress were delivered by Dr. Ernest Gram on ' Factory, Forum and Fields ' ; by Prof. J. H. Burn, F. R. S., on the ' Poisoning of Crops ' ; by Dr. Ferdinand Beran on ' The Effect of Oil Sprays ' ; by Dr. Julio de Soto on ' Problems of Locust Control in La Plata ', and by Monsieur J. Faure on ' the Application of Synthetic Organic insecticides in Fruit Cultivation in France '. A number of tours, visits and demonstrations were arranged including the laboratories and experiment stations of Messrs. Pest Control Ltd. at Bourn, Messrs. Plant Protection Ltd., and I. C. I. at Fernhurst, Messrs. F. W. Berk at Tilgate, Messrs. Boots Laboratories at Nottingham, Messrs. Murphy Chemical Co. and the Experiment Stations at East Malling, Long Ashton and Rothamsted.

The opening session was held at the Royal Institution, Albemarle Street, when Lord Bledisole delivered his Presidential address.

Presidential Address

In the course of his address Lord Bledisole referred to the enormous losses sufferred as a result of the ravages of pests and diseases of crops. They had been stated by some to be as high as 50 per cent of the crops grown, harvested and stored ; even if this figure was regarded as excessive he thought that at a conservative estimate they could be placed at 30 per cent excluding losses due to weed competition.

The authorities of F. A. O. had stated that the total annual losses of grain crops in the world as a result of pests and diseases amounted to 65 million tons, while the late Dr. Scott Robertson had pointed out that if they could be reduced by only 10 per cent it would make available an additional 6½ million tons of grain annually which would go a long way towards alleviating some of the more acute shortages of food in many countries.

In the United Kingdom alone the annual loss from potato blight was estimated to be 10 per cent of the total crop, and even after the crop had been harvested there was a further loss in the potatoes stored in the clamps which, on the average of the last eight years, amounted to 8 per cent.

It was frequently assumed that the present world shortage of food stuffs was the direct outcome of the war and that in the not-too-far distant future matters would adjust themselves automatically and there would be a return to the conditions of pre-war plenty. Such an assumption overlooked two facts, one was that even in pre-war days owing to maldistribution of purchasing power large sections of the population were insufficiently nourished and the other was that in the interval since 1939, the population of the world had increased by 250 million, while world standards of living were also rising. In consequence there was an urgent need to increase production and to reduce avoidable losses.

It seemed curious that in these circumstances far too little attention was yet paid by the majority of farmers to crop protection. Every good farmer realised the advantages to be derived from manures and fertilisers, but few appreciated that gains equal to those derivable from fertiliser applications could be obtained by the judicious use of weed killers and other methods of crop protection.

Overseas the position was the same ; it was true that in some cases spectacular success had been achieved, a notable instance was the manner in which it had been possible to combat locust outbreaks by the use of benzene hexachloride but in other cases large losses, many of them preventable, occurred. As examples could be cited the formidable losses suffered by the Australian wheat industry as a result of fungoid disease, in Italy one third of the olive crop was lost as the result of pests, while in West Africa the only available means of combating the virus disease which attacked the cocoa crop was the wholesale destruction of trees which were still in bearing.

It was universally agreed that to meet the world's needs there must be increased production ; this could be secured in some cases by increasing the areas cultivated, but in many countries the majority of the good cultivable land was already under cultivation and the chief hope lay in increasing the yield per unit area by intensified husbandry. This, however, was insufficient unless it was accompanied by adequate measures to protect crops from losses from pests and diseases.

Crop protection moreover must not be thought of merely as the protection of the growing plant. Some of the greatest losses occurred among stored products after the crop has been reaped. The work of the Pest Infestation Branch of the D. S. I. R. had shown how large these losses had been in this

country ; overseas they were even larger particularly in some of African and Eastern tropical countries, owing to infested warehouses and infested ships. The percentage of infested ships coming from African ports was particularly high.

During and since the war, knowledge concerning methods of control had greatly extended. Research had brought to light a large number of new substances which could be used in control of pests and diseases, new methods of application had been devised and great improvements introduced into those previously practised. Research had done this and much further research was needed. There was, however, special need that new methods should be explained to cultivators and their value and practical utility fully demonstrated.

There was at present a tendency for research to be concentrated upon purely chemical methods of control. This was, perhaps, understandable since the chemical industry was probably better organised than any other branch to prosecute it while from the purely commercial point of view there were obvious inducements to find, manufacture, and market products likely to command a ready sale.

It must, however, be remembered that biological and physiological methods of control were of equal importance, and might in some circumstances be preferable to and more effective than purely chemical methods. In particular the use of parasites and predators on insect pests, physiological conditions as influenced by soil and water conditions and particularly the breeding of disease resistant strains of crops making use of inherited characters, all offered enormous possibilities and had already demonstrated their value in many cases. From the point of view of international food supplies, if for no other reason, it was essential that adequate funds and resources should continue to be available for research on these aspects.

The preventable losses of crops and crop production owing to pests and diseases were of staggering size and presented an epoch making challenge to science. The question was whether scientists were prepared to accept this challenge and thus ward off from the world a worse calamity than might occur from the use of the atom bomb. The answer from scientists must undoubtedly be 'yes'.

Summaries of important Discussions and Papers etc. furnished by Mr. N. C. Pant, an overseas scholar of the Directorate of Plant Protection, Quarantine and Storage in U. K. who attended the Conference as an observer on behalf of the Government of India.

Chemical Properties of certain Organo-phosphorus Compounds in Relation to their use as Insecticides

BY

H. Martin (Great Britain)

Owing to the lack of knowledge of the chemical structure of organo-phosphorus compounds (esters and amides of phosphoric acid) it is difficult to

generalise about their toxicity and stability. The following tentative rules, although with some reserve, can be laid down to describe the general behaviour of these compounds.

(*i*) In compounds of the types :—

(RO) 2 PX. Z (I) and (R_2 N_2) PX. Z (II) where X=O or S, the group Z should be such that HZ has acidic properties (Schrader). The special property of mioti action is limited, in the esters (I), to Z=F.

(*ii*) The converse of Schrader's rule, that if HZ is acidic the compounds (I) and (II) are insecticidal has many exceptions *e.g.*, the inactivity of chlorophosphonates.

(*iii*) If HZ is a substituted phenol, toxicity is increased by the introduction of electron-attracting groups in the *para position*. Yet, if in (II), Z is the 2-methyl 4 : 6-dinitrophenoxy group, the compound has little insecticidal activity though the phenol is an established insecticide.

(*iv*) The choice of alkyl group R in both series is not critical, though secondary alkyl groups enhance mammalian toxicity (*c.f.* di-isopropyl fluorophosphonate).

(*v*) Substitution in the alkyl radical reduced toxicity (*c.f.* bis 2-chloroethyl) fluorophosphonate ; bis (2-chloroethyl) di-nitrophenyl thiophosphate). Stability to water is requisite in a protective insecticide or one suitable for application with alkaline spray materials ;

(*vi*) In compounds of type (L) the thiophosphates are more resistant to hydrolysis than the corresponding phosphate (Schrader). This fact has also been confirmed by Coates. In Long Ashton Research Station, however, tetraethyl dithiono-pyrophosphate was found, in solution, to lose insecticidal potency at about the same rate as TEPP.

(*vii*) The amides derivatives (II) are more resistant to hydrolysis than the corresponding esters (I).

(*viii*) Insufficient evidence is available to judge whether the effects of Z on the stability of the esters (I) are in accord with accepted electronic theories. Stability to heat is of interest mainly in the preparation and manufacture of the thiophosphates. Isomerization of the type :

$$(RO)_2\ PS.Z \rightarrow (RS)\ (RO)\ PO.Z$$

first observed by Emmett and Jones in 1911 with trimethyl thiophosphate is stated by Schrader to begin in diethyl p-nitrophenyl thiophosphate at 13°-14°C. It has been found that insecticidal properties (to *Calandra granaria*) of this compound rapidly decreases at 14° C and falls parallel to the content of thionosulphur.

Parathion and E 605 Analysis and Some Chemical Properties.

BY

J. A. A. Ketelaar (Holland)

Dr. Ketelaar gave a method of analysing technical Parathion and E 605 and proprietary mixtures containing them. The method is based on the determination of an esterified para-nitrophenol which is a constituent of Parathion and E 605 (diethyl-p nitrophenyl thiophosphate). The amount of bound nitrophenol is found as the difference between the total contents of nitrophenol as determined after saponification with boiling alcholic substance and the contents of free nitrophenol as found by extraction with 1 percent soda solution. The nitrophenol was determined calorimetrically in 0·1 N sol. of NaOH at 405m.

Amount of sulphur, double bonded to phosphorus was determined as $BaSO_4$, after oxidation with 50 percent HNO_3.

The ultra violet and infra-red absorption spectra were determined for Parathion, E 605 and related substances such as triethylthiophosphonate and other esters of thiophosphoric acid in which one, two or all three ethyl groups had been replaced by nitro-phenyl group.

Studies on the rate of hydrolysis by hydroxyl ions of both substances were made at different concentrations and temperature. It was found that Parathion can only be used with alkaline liquids where direct effort only matters as a residual effect will certainly be destroyed. All E 605 preparations give a rate of hydrolysis 4 times higher than Parathion preparations. As this effect cannot be attributed to the catalytic influences, it means that Parathion and the active principles of the difference lies in the nature of alkyl group. E 605 is less stable towards alkali and lime than Parathion.

The Toxicity of Organo-Phosphorous Insecticides to Mammals

BY

K. P. Du Bois (U. S. A.)

Organo-phosphoric compounds have systemic value. Their increasing use has necessitated to find out their toxicity to the higher animals. Large number of organic phosphate esters have been studied from this point of view mainly TEPP (tetraethyl pyrophosphate), HETP (hexaethyl tetraphosphate) and Parathion (p-nitrophenyl diethyl thiophosphate). All these are highly toxic to mammals and precaution should be taken to avoid exposure of men during the handling and to prevent the contamination of foods. Oral administration of the substance had been found to be fatal to the mice, which show the cumulative effect from the repeated exposures. These esters seem to effect nervous system in which the inhibition of acetyl choline esterase by the insecticides appear to play the dominant role. It has been found that a substance called acetyl choline is produced in the body tissues but is immediately neutralised by the action of the enzyme called Cholinesterase which is inhibited by the action of these insecticides. The

destruction of Cholinesterase leads to the accumulation of acetyl choline which has a poisoning effect on the body tissues, 1 g/kg. of the body weight administered by mouth being known to be fatal to man.

Experiences with Parathion on a Field Scale

BY

G. L. Hey and A.H. Mitchell (Great Britain)

Parathion was used on a large scale and compared with the standard insecticides in common use. The results are given below :

Red Spider.—Mature females are killed by the action of the insecticides' which does not seem to have an ovicidal property. The mites that are not directly hit are killed by the residual effect of the compound. One application in May and one after about 40 days gives an adequate protection to the plants. Parathion was either applied alone (8 oz. per 100 gal. water) or with lime sulphur wash.

Hop Red Spider.—Spiders which escape the treatment being on the under side of the leaves multiply and infestation becomes well marked when the action of Parathion is destroyed.

Apple Sawfly.—0·05 per cent Parathion with or without nicotine has been found to be very effective. It can also be used with lead arsenate.

Aphids of Apple.—Under low temperature Parathion gave very good results, even better than DDT.

Caterpillars.—Parathion is not very effective against caterpillars in general.

Green House Pests.—It is very efficient against the green house pests like leaf-miners. The concentration should not exceed 0·01 per cent. Parathion was better than HETP.

Parathion was also found to be effective against Woolly Aphis but there is a drawback that it does not wet the scales.

The Analysis of P-nitrophenyl Diethyl Thiophosphate (E 605 ; Parathion)

BY

J. G. Gage (Great Britain)

Due to high toxicity of these substances it is necessary to know more about the methods of analysis to determine the concentration in the atmosphere during manufacture and application. Estimation of residual E 605 on the treated crops is also important. The method of analysis (Avrill & Norris) has also been used with some modification.

The Practical Use of the Systemic Insecticides

BY

R. M. Greenslade (Great Britain)

A brief survey of some experimental work with *bis* (bis dimethylamino phosphonous) anhydride as a systemic insecticide was recently published in Nature *163* : 787-789, 1949. New methods of application of this material in known doses to plant are devised. It has been found that treated plants have no repellant effect on aphids which continue feeding until, presumably, they have accumulated a lethal dose. The younger stages are more quickly killed than the adults. Coccids are killed but are much more resistant than aphids. The mortality of insect depends on the concentration applied to the plant. The systemic insecticide is absorbed by leaves and the sap becomes poisonous to the insects especially of the sucking type. Predaceous insects like Lady bird beetle are not killed as this insecticide does not act as a contact poison.

Practical applications showed excellent results on the control of Hop-aphis. 1,000 acres of Hop were treated. Long residual effect of this insecticide cuts down the spraying cost. Two sprayings are sufficient. 0·0312 per cent of the insecticide gave good results with bean aphis. To find out the actual concentration of insecticide needed to kill the insect in question, the insects were fed on the chemical solution of insecticide through membrane. Other methods included the use of the Potter's Tower.

Experiments with Organo-Phosphorous Insecticides acting Systemically

BY

W. A. L. David (Great Britain)

McCombie and Saunders in England and Schrader in Germany have synthesised many organo-phosphorus compounds. They vary in toxicity to the mammals. Less toxic substances can be used as insecticides which act systemically. These insecticides are distributed to all parts of the plant and kill insects not readily accessible to dust or spray. Some of these organo-phosphorus compounds are effective fumigants or contact insecticides but these acting systemically may not show high contact toxicity. Systemic action is apparent when the insecticide is added to the soil or culture solution. Aphis are readily killed and so statistical procedures have become an integral part of the technique for the analysis and expression of data and estimation of the significance of the results.

Laboratory studies are only likely to prove an approximate guide in the field.

The Toxicity of Certain Contact Insecticides to the African Migrating Locusts

BY

H. S. Hopf. (Great Britain)

The following substances have been studied with locusts and they are mentioned in order of toxicity. P-nitrophenyl-diethylthiophosphate

E 605), gamma BHC and dinitro-o-cresol, Chlordane, (1, 2, 4, 5, 6, 7, 8, 8-octachlor-4, 7-methano-3a, 4, 7, 7a-tetrahydronidan), Chlorinated camphene and DDT.

An apparatus called " Microdrop Syringe " was used to deposit a known volume of the insecticide on to any part of the insect body. This is an adaptation of the apparatus developed by the Chemical Defence Research Station, Porton. It consists of an " AGLA " syringe which is really a precision-made hypodermic syringe. The piston is worked by a micrometer, which is worked by a rotating drum through a reduction gear. Each division on the latter corresponds to 0·00001 ml. A repeatable drop can be obtained at 5 div. with an error of ±5 per cent. A drop of this size would not fall off the point of the needle. This is, therefore, mounted in an air nozzle and, depressing the valve, a puff of compressed air blows the drop downwards. This apparatus has also been used with mosquitoes.

Toxicity of Insecticides to the Mammals and its Evaluation

BY

H. Taylor (Great Britain)

An insecticide may be picked up through mouth, skin or lungs by the higher animals. The acute toxicity by the mouth is found by administering the compound by means of a stomach tube, the dosage being varied until a point is reached somewhere within range of the 50 per cent kill point.

Toxicity via the skin is studied by applying the compound to shaved areas on the animals and also by the subcutaneous and intraperitoneal injections.

Absorption via the lungs can be easily studied in the case of fumigants but is rather difficult with sprays and dusts.

The chronic effect of absorbing small amounts over periods are of great importance especially when there is a possibility of residues persisting on the food stuffs and certain larvae. Some of these insecticides are also phyto-toxic.

60 mg. of bis (bis-dimethylamino phosphonus anhydride) per kilo of the plant tissue has a toxic effect. Plant remains toxic for over three weeks. With some other compounds the plant may not remain toxic after few days. This suggests that the insecticide is decomposed or lost by vaporisation and that the treated plants may be harmless to the mammals. That some toxic materials are lost from leaves in vapour form is suggested by the observation that aphids on an untreated plant are killed when it is enclosed with a treated plant.

Biological Methods for the Studies in Laboratory of Insecticidal activity : Their Scope and Validity

BY

C. Potter (Great Britain)

For testing the deposits on the surface or on the test insect Potter's Tower was widely used. The need of specialized protective equipment also for operatives who are liable to pick up small amount of the insecticidal material daily was stressed.

Recent researches have given some indication that derris and pyrethrum are as toxic as DDT or gamma BHC. Organo-phosphorus compounds (TEPP : HETP : and E 605 or Parathion) are many more times toxic and hence need special care in handling in factories or farms.

Physiological Aspects of the Action of DDT

BY

D. Dresden (Holland)

Action of DDT on *Rana* and *Periplaneta* was studied to find out (*i*) how can the specific contact action be explained ? (*ii*) what is the cause of the DDT symptoms ? (*iii*) what is the cause of the death after DDT poisoning ? It was found that both in *Rana* and *Periplaneta* the cause of the symptoms is the same.

From an analysis of the action of DDT on nervous system it appeared that the compound has no influence on sense organs, peripheral nerves, spontaneous activity of the centres (brain and spinal cord in *Rana* and the thoracic ganglia in *Periplaneta*) myo-neural junctions and muscles. If, however, the reflex arc is intact, and increased frequency of action potentials can be recorded from the sciatic nerve (*Rana*) and crural nerve (*Periplaneta*), the DDT poisoning causes the normal flow of afferent impulses. It is the synapses which must be regarded as the site of the action. Symptoms are caused by facilitation of synaptic transmissions. Death is caused by an action on synapses.

Insecticidal Action of Some Halogenated Organic Compounds

BY

Wood Cock (Great Britain)

Various theories were discussed in attempts to explain the remarkable insecticidal value of these compounds. The toxosphere concept, the dehydrochlorination hypotheses, and the idea that toxic action is due to the structural resemblance to and competition with an "essential metabolite" are discussed in relation to BHC, DDT and its analogues and a series of chlorinated 4-chloro-l-ethylbenzenes.

The Effect of Phase Distribution on Deduced Relationship between Chemical Constitution and Toxic Action

BY

J. Ferguson (Great Britain)

Concentrations of toxic substances measured in the environment of an organism subjected to their action are a function of at least 3 variables :

(*a*) the effective concentration which is required for a definite time at the actual point or points of attack within the organism—the intrinsic toxicity,

(*b*) the distribution coefficient of the substance between the environment and the affected biophase in the organism, and

(*c*) the rate of the penetration of the poison into the organism. The last factor is itself a function of the distribution.

The presence of the various substituents and the grouping in the toxic molecule can affect all or any of these variables. It was found while working with hydrocarbon gases on the beetle *Calandra granaria* that the introduction into hydrocarbon molecules of substituents such as Cl, NO_2, CNS, OH, OH_3, modified primarily the distribution coefficient between external phase and the affected bio-phase. The substituents are not " Toxophores " *i.e.* groupings which alter intrinsic toxicity though there are examples in which they do so act.

Section I

Effectiveness of Chinese Insecticidal Plants with Reference to the Comparative Toxicity on Botanical and Synthetic Insecticides

BY

S. F. Chiu (Canton, China)

Nine species of the insecticidal plants were tested against 40 species of insects. Three plants *Millettia pachycarpo*, *Triptergium forrestii* and *Rhododendrum molle* were studied in detail. In none of the cases the results were as good as with gamma BHC or DDT. Fine ground seeds of the rotenone bearing plants *Millettia pachycarpa* were suspended in water and applied. They gave very good results against aphids, Pentatomids.

Development in the formulation and application of DDT

BY

G. A. Emery and V. H. Chambers (Great Britain)

Different formulations like dust, oil solutions, powders, were reviewed together with their shortcomings.

The latest formulation is microcrystalline suspension of the paste. The crystals of the DDT paste are uniformly of 6 × 1 micron in size. No loss by absorption into fabric of the spray surface occurs with the paste.

Important new methods of application are paint spray guns and gas jets which enable concentrated water suspensions to be applied in an almost invisible form and with remarkable evenness.

A new aerosol machine called " TIFA " has been found to be very useful to generate fogs of the insecticides. It is specially suited for the malaria control work.

Wire worm Control with Benzene hexachloride with Special Reference to Seed Dressings

BY

J. H. Stapley (Great Britain)

The wire-worm is the important pest of agricultural crops in Britain. It attacks a wide range of crops particularly cereals and sugar beet. BHC was first tried in 1944. 1½ cwt. dilute powder of BHC per acre applied at the

time of making the seed-bed gives a very satisfactory control. For cereals, ½ cwt. to 1 cwt. is sufficient. Effect of BHC is immediate on the wire worms which cease to feed and die slowly. Many come upto to the surface and die. The effect of the insecticide seems to last for 2 years at least.

Persistence of DDT and BHC in the Soil

BY

M. S. Smith (Great Britain)

It is well known that BHC and DDT are highly persistent. Their persistence in the soil is now becoming a subject of studies. Both acid and alkaline soils alone and mixed with 2 per cent DDT or 2 per cent BHC (mixed isomers containing 10 per cent of the gamma isomer) were exposed to the outside condition and also subjected to the controlled leaching. It was found that both DDT and BHC were very stable in the soil even after 18 months. Bacterial counts of the soil showed no harmful effect of these substances on the microflora of the soil. BHC showed some phyto-toxic effect. A concentration of 0·002 per cent of the gamma isomer of BHC has adverse effect on the root development. This is not the case with DDT which is, therefore preferred as a soil insecticide.

A Review of Recent Research on the Synthetic Acaricides

BY

J. K. Eaton (Great Britain)

Due to commercial and large scale use of the insecticides it was found that in certain crops other pests became more important. The spider mite is one of such pests. Various chemicals have been tried as acaricides. 2 : 4—dinitro-6-cyclohexyl phenol (DNOCHP) is found to be toxic to *Tetranychus pilosus*, *T. bimaculatus*, and *T. telarius*. It is also phyto-toxic.

In 1945 the value of azobenzene as fumigant for the control of the glass-house red spider was recognised. But this substance is also phytotoxic Eaton and Davies (1948) found that diphenyl sulphone gave very good results and is not phyto-toxic. Other acaricides which are showing promising results are di(p-chlorophenoxy) methane and di (p-chlorophenyl) methylcarbinol. The latter is not phyto-toxic.

Organo-phosphorus compounds like HETP, TEPP and E 605 are being investigated as acaricides. They are not effective against the eggs but two timely sprays have been found to control the summer forms. HETP and TEPP cannot be used with alkaline washes while E 605 can be safely used.

Comparison of the Sensitivity of Various Insects and Mites to Some Mineral Oil Fractions

BY

G. F. E. M. Dierick (Holland)

Several insects have been tested to find out the effect of oil sprays on to them. Insects used as test materials were *Ephestia*, *Paratetranychus ulmi*,

and adult *Aonidiella*. It has been emphasized that *Ephestia* can be used as a test material to give reliable data and results for mites so difficult to rear under laboratory conditions.

DD—A Soil Fumigant against *Heterodera marioni* in the U. K.

BY

W. Heeley (Great Britain)

Until recently soil-steaming was used for controlling plant nematodes. Nowadays DD., a liquid mixture of 1 : 3 dichloropropane and 1 : 2 dichloropropane is used as soil fumigant. In 1946-47 trials were carried out at 20 glasshouses of nematode. Soil-steaming proved in-effective; 400 pounds of DD per acre gave excellent control which depends on soil treatment, temperature, moisture and thoroughness of application. DD has a persistent effect. It is ten times cheaper than soil steaming. DD is added to soil after which it is irrigated and the field is left for one month. The main reason why steaming fails is the fact that only top 18 inch soil gets the treatment while the nematodes can penetrate deeper.

Standardization of Fungicides and Insecticides in Finland

By

H. J. E. Hardh (Finland)

In the present post-war period many preparations of crop protectives are coming in the market. In Finland, as in other countries, these substances have advanced crop protection but at the same time leave the growers uncertain in selecting the right type of the preparation. A committee was formed in 1948 to organise an official examination of all imported and home-made pesticides. The phytopathological research is being carried out by the Department of Phytopathology and Entomology at the Agriculture Experiment Station in Tikkurila. In 1948, 68 fungicides and 79 insecticides were tested at this Station. The main aim of this scheme is to remove from the market the inefficient and injurious preparations and to recommend the tested products.

The committee has made a suggestion that law be passed in Finland by which the examination of crop protectives shall be voluntary. In some countries it is compulsory. When the importer or manufacturer applies to have his preparation tested the Plant Protection Institute will supply him with the information regarding the diseases, weeds and the insects against which the preparation tested is found to be effective. It also gives the concentration of the active principle and the amount to be used in the control of a certain pest. Every container would bear the certification of this test. For tests against each disease, weed or pest the manufacturer or importer has to pay £4 to £9. The results of these tests are published from time to time in periodicals and newspapers.

A Scheme of Insecticide, Fungicide, etc. Supervision in Sweden based on an Agreement between Authorities and Associations of Manufacturers and Merchants

BY

S. Bergman (Sweden)

In 1947 Swedish manufacturers and importers of insecticides and other pesticides formed a union and in 1949 this union started a supervising activity in connection with a guarantee mark. This mark is registered and is not used without a license of a board, the members of which represent unions of manufacturers, merchants and publicity men as well as those authorities who are in charge of testing pesticides of different kinds. The president of the board is a supreme court judge with many years experience also from arbitration courts in Swedish trade.

If a manufacturer or importer wishes to acquire the guarantee mark he has to apply to the office and present labels, direction for use, certificates etc. He may then be entitled to use the mark on the containers of his pesticides as well as in advertisements and he has to pay an annual fee on a contribution to cover the costs of the supervising office. It is in the power of the board to withdraw at any time the license for using the mark if a manufacturer or importer is disloyal, or if his preparations are adulterated or are claimed to possess a higher efficiency than can be proved.

Appendix

Application Equipments

(*a*) '*Autoblast*' *Sprayer*.—This machine is made by Kent Engineering and Foundry Ltd. It is based on the principles of dispersing concentrated insecticide into very fine particles with the help of airblast. The machine creates a 100 m.p.h. gale at the point of ejection by means of a fast revolving fan rotating in an enclosed cylinder. Into this blast of air the insecticide is introduced, by a bank of nozzles, at low pressure, just sufficient to atomise the insecticide, and the air blast carries the globules of wash into the trees as the machine is hauled between the rows. The spray is delivered in a semi-circle from the rear of the machine, at right angles to the line of travel and fans out from the ground on one side to the ground on the other side, to a diameter of approximately 30 ft.

The quantity of the wash can be controlled in sections so that the delivery to any particular segment can be varied according to the nature and the size of the trees and the direction of the wind, etc. This machine can be hauled by any suitable 25 h.p. tractor and is capable of spraying 30—35 acres of orchard per day. It is also possible to handle dry powder and a combination of dry powder and water with a modified version of this machine.

Based on this principle of dispersing the insecticide with air blast, are many other boom sprayers which are used for the agricultural crops like potatoes. The nozzles at the boom are encased on three sides by air nozzles which deliver air blast at a high velocity to disperse the dripping insecticide.

The plants are shaken by the insecticide laden air blast, and thus there is complete coverage of the whole plant including the under side of the leaves which are not hit by the ordinary sprayers.

(*b*) *Tifa.*—(Todd Insecticidal Fog Generator) Made by The Lister-Todd Engineering Corporation, Ltd., London. This is an extremely effective machine developed from the fog generators designed and produced during War II by Todd Shipyards Corporation of New York. It is designed to produce Thermal Aerosols of selected droplet diameters. The insecticide, dissolved or suspended in a carrier liquid, is first atomised mechanically and then introduced into a blast of hot air and further fractionized. On contact with the atmosphere this material becomes a true fog which disperses over wide areas, enveloping everything in its path and penetrating the smallest crevices. Fog droplet size can be controlled from 0·5—100 micron. Liquid consumption ranges from 12-35 Imp. gals. per hour according to the droplet size of the fog. Approximately 150 cu. ft. of the free fog concentrate are emitted per minute. At a 10 micron size setting this quantity of concentrate will expand to give a dense fog filling 15,000 cu. ft. of space. To work this machine 2½ gals. of petrol is needed per hour.

It has been found of much use in the malaria control, and various insecticides have been used in this machine, DDT, BHC, Chlordan, Pyrethrum, DNOC, (Dinitro-ortho-cresol,) Derris, etc.

This machine was demonstrated by Messrs Murphy Chemical Co., Ltd., on 30th July.

Helicopter Spraying.—(Spraycopter'—Pest Control Ltd., Cambridge) :— This machine can spray 600 acres a day under best conditions, average being 400 acres. It can be operated a few feet above the ground and can travel at a speed of 80 m.p.h. The working speed varies from 12-30 m.p.h. For the big trees the speed is kept slow while it can reach the maximum with a field crop. Cost of working is higher than any of the ground machines.

Its high quality of work is said to be due to the ability of its rotating direct downward a bell shaped current of air into which the spray is introduced by 100 nozzles arranged on spray-booms similar to those in ground machines. When the spray-laden air reaches the ground it covers the leaf surfaces not only from the above, but by rebounding reaches the vertical and under surfaces.

The machine has 450 h.p. radial engine and a 3 h.p. auxiliary engine to drive the spray pumps. The tank capacity is 70 gallons. The chemical is discharged through spray bars and nozzles extending 17 ft. on each side of the aircraft.

SHORT NOTES AND NOTICES

Assessment of Damage by Pests in Kumaon (U.P.)

" I have been greatly struck during my present visit to Kumaon Hills with the immensity and seriousness of pest and disease problems. For example I have seen many potato fields where *Epilachna* beetles have completely ruined the crop and the loss can easily be put down as cent per cent. I am getting the total amount of loss caused to the potato crop in the Kumaon Hills calculated by this one pest alone. Several species of defoliating beetles are another group of pests of apple, peach, plum and other trees which have caused havoc in many orchards. The grubs of these beetles damage the potato and other kharif crops in many areas. Field rats have caused serious losses to crops as well as to seedlings of fruit trees. While flies appear to be responsible for much damage to citrus trees in the valley areas, stem-brown, collar-rot and stem-black diseases of apple trees and various types of blights on fruit trees are also serious problems. I think we shall have to work hard for a long time before we may bring these pests and diseases under control over large areas in Kumaon Hills." Extract from a letter dated June 12, 1949 from the Entomologist to U. P. Government.

Cost of Spraying Potatoes against Early Blight in West Bengal

How much does it cost to spray an acre of potatoes against early blight in India ? In a cooperative effort with the Imperial Chemical Industries (India) Ltd., the West Bengal Department of Agriculture conducted trials in 1948-49 on 342 acres of potato fields in Burdwan district, where early blight appears every year, causing much damage to the crop. Four pounds of Perenox dissolved in 100 gallons of water were used per acre and sprayed with a Hydrolux Sprayer powered with a two-stroke 1·5 h.p. engine for developing the pressure.

Spraying 5 acres per day, it took 69 days to spray 342 acres. The wages of the mechanic amounted to Rs. 276/-, while a sum of Rs. 506/- was paid to him as daily and travelling allowances. The cost of the fungicide to spray 342 acres amounted to Rs. 2308-8-0. A sum of Rs. 8/- was figured as the cost of fuel to run the machine, and depreciation of the spraying machine was calculated at Rs. 174/-. The grand total amounted to Rs. 3,273/- or Rs. 9/9/- per acre for a single spray. As two sprays were given at an interval of ten days, the cost per acre amounts to Rs. 19/2/-.

By investing a sum of Rs. 19/2/- per acre, the farmer obtained 20 maunds more of potatoes. Calculated in terms of money, this means a profit of about Rs. 200 to 250 per acre of potato crop. Extract from *Ann. P. Prot. Rept.* West Bengal, 1948-49.

Storage of Citrus Fruits Prolonged

Results of experiments carried in California for the last two years and a half indicate that preharvest drop sprays also prolong the storage life of citrus fruits.

2,4-D, and the less known preparation 2,4, 5-T (*i.e.* 2, 4, 5-trichlorophenoxyacetic acid), are usually used as preharvest fruit-drop sprays. spraying with 2,4-D preparations considerably prolonged the storage life

of oranges, grapefruits and helped to check development of such storage disorders such as black button and internal decay due to *Alternaria* sp. In case of lemons 2,4,5-T proved four to five times as effective as 2,4-D in reducing black buttons on green lemons.

After-harvest dip of lemons in a lanolin emulsion of 2,4-D also prolonged the keeping qualities of the fruits, but 2, 4-D vapour treatment for 69 hours was less efficacious than the dip treatment. Extract from *Calif. Agriculture* June, 1949–pp 7 & 14.

Progress of Plant Protection Work in Madras.

Co. 25 and 26—Blast Resistant paddy strains.—In the 1948-49 season, the Taladi (Second) paddy crop in the districts of South Arcot and Tanjore was observed to be severely attacked by stem borer and *Helminthosporium.* In the middle of these affected areas, plots planted with Co. 25 and Co. 26 were found to be comparatively resistant to the pest and disease mentioned. These two strains, being primarily resistant to the blast disease, are recommended for a large scale cultivation in the southern and central districts. Arrangements are being made to stock large quantities of seed for distribution during the next crop season.

Duck for Combating Pests : Biological Control.—A severe attack of the striped bug was noted on a compact block of 13 acres at Kattuputtur in Tiruchirapalli district. A flock of about 1,000 ducks was let into the field as an experimental measure. The result was astounding. Each duck was capable of accounting for about 500 insects in the course of a day. The whole field, infested with the insect, was cleared of the pest in the course of five days. There was no need for treating the field with chemical insecticides.

Gammexane saves Paddy from Caterpillar.—During the month of January reports were received of the appearance of the swarming Caterpillar (*Spodoptera mauritia*) pest in the second crop (*dalva*) paddy seedbeds in Bhimavaram taluka of the West Godavary District and Amalapuram and Razole taluks of the East Godavary District. Due to the remedies of flooding, kerosination and letting in ducks, approximately 60 acres of seed beds, distributed in small patches over the area, were saved. But the pest reappeared in the broadcast and transplanted fields. The usual mechanical methods could not be adopted in the transplanted crop, because the bunds were not high. To meet this rapid spread of the pest in the transplanted fields, Gammexane D.0·25 was rushed to the area. The success with use of Gammexane D.02·5 against swarming caterpillars was so telling that ryots regretted that this was not tried earlier. A total area of 600 acres was estimated to have been treated with the insecticide. It is effective on young caterpillars, as well. It was used at the rate of 12 to 20 lbs. per acre, costing Rs.1-14-0 to Rs. 3-2-0 for the insecticide and Rs. 3 for manual labour to dust. It is estimated that on an average 72 bags of paddy of the value of Rs. 80/- per acre, was saved by spending Rs. 5/- to 6/- in the control of the pest. In addition to the direct saving of the affected crop, a considerable area has been saved by this timely action, in checking the spread of the caterpillar marching from field to field. The total paddy crop saved from this

dreaded pest on paddy in the second crop season of 1949 in the Godavari Delta is estimated at 3,000 acres and the value of the produce of the crop so saved may be computed at a conservative estimate to be of the tune of Rs.2,40,000. Extracts from *Agricultural News letter* Madras, May 1949.

"Bunchy top" Disease of Banana

" Bunchy top " of bananas is a virus disease of great economic importance. Severe losses to the banana industry have been reported from Fiji, Australia, Egypt, Trinidad, Ceylon and New South Wales due to this disease. In India it has been recently reported from Travancore and Cochin. There are references to literature about its occurrence in Assam and Orissa, but the diagnosis of the disease has not been confirmed at these places.

Symptoms.—Bunchy top is primarily a phloem disease and seriously interferes with the translocation of food materials. It causes dwarfing and rosette of leaves. The suckers become small and the affected plants do not bear fruit. Green streaking of vascular traces in the lamina, midrib and petiole of the leaves are chracteristic symptoms of the disease for field identification.

The insect vector *Pentalonia nigronervosa* Coq. is chiefly responsible for its spread from plant to plant.

Control.—The disease has been successfully controlled by the use of resistant varieties, by placing under quarantine all the affected orchards and by cutting off the affected plants at the ground level, making a hole in the root-stock and pouring crude oil slush within it. The cut plants are burnt and the crude oil slush kills the root stocks and thus prevents sucker formation. (Dte. of P.P.Q. & S.)

New Development in Chemical Control of Noxious Perennial Grasses

Preparations such as 2,4-D, Methoxone, Agroxone, etc., are known to effectively eradicate broad-leaved (dicotyledonous) weeds. But no chemical was so long known that will permanently kill noxious perennial grasses.

Recent trials in the United States of America indicate that Sodium TCA (Sodium trichloroacetate) offers a practical means of permanently controlling perennial weed grasses. Sodium TCA is now being used over many parts of U.S.A. to kill perennial (and also annual) grasses along roadsides, fence-rows, irrigation ditchbanks, and in cultivated fields. In general, it is used at the rate of 40 to 140 pounds per acre (mixed at the rate of one pound of sodium TCA to one to two gallons of water) for the control of established perennial grasses. (AIF News).

Tuber Moth and Cutworm of Potato in the Nilgiris

The potato tuber moth (*Phthorimoea operculella* Z.) and the cutworm (*Euxoa segetum* S.) are two important insect pests of potato crop in the Nilgiris which deserve a careful control.

Tuber moth.—The damage is caused by caterpillars which bore into the tubers even in the field and continue damaging in the godowns from where

the infestation may again be carried to the fields. Usually the seed material suffers relatively much more than the edible grade as the latter is disposed off quickly. The pest thrives more during warm, dry and sunny weather from February to May.

In the Nilgiris the irrigated crop suffers more both in the fields as well as in the godown whereas the next crop during August-February and January-April are mildly attacked.

Dusts such as DDT, BHC, pyrethrum, derris, tobacco are satisfactory but have not so far yielded any conclusive results. However, parasitization of the eggs by *Trichogramma* spp. in some of the godowns brought down considerably the population of moths. Dusting of godown with D.O25, BHC and DDT 10 per cent gave satisfactory results.

Cutworm attack is particularly serious during February-April. Its activity accelerated during sunny and dry weather. Dusting with D.O25, BHC, about a month after planting gives satisfactory results. (Extract from Report, Madras Deptt. Agriculture).

Diseases of Bajra in Rajasthan

The most important cereal crop in Rajasthan is bajra. During a recent trip by truck from Jodhpur to Bikaner a survey of diseases of this crop was rapidly made. Bajra fields picked up at random were carefully observed and it was noted that the downy mildew due to *Sclerospora graminicola* (Sacc.) Schroeter caused a good deal of damage. When random counts were made, it was observed that the incidence of the disease was 5 per cent in some fields and upto 50 per cent in other fields. It was noted that where the attack was rather late, there was some grain formation in the ears but when it was early, there was no yield at all. The cultivators complained that the disease was doing much harm to the crop and wanted to know the methods of control.

While a great deal is known about the morphology and physiology of the causal fungus, precise methods of controlling the disease are yet unknown. It is believed that the oospores of the fungus that remain in the soil germinate soon after the crop is sown and infect the plants. The oospores are also stated to be carried over by seed. While it is possible that these are the methods by which the fungus perpetuates itself from year to year and is transmitted from crop to crop, precise methods of controlling it, as already stated, are unknown. It is time the Plant Pathologists of those provinces where bajra is grown and the downy mildew is a serious problem, took up this disease for intensive investigation so as to find methods for its control. (Dte. P. P. Q. & S.).

Use of Pyrethrum Insecticides against Vegetable Pests

Pyrethrum powder ranks high as an insecticide in the control of insects of public health importance. Recently, however, the use of this insecticide was seriously considered in plant protection work, particularly in the case of vegetables which should not be treated with the common mineral and synthetic insecticides due to toxicity hazard. Two of its products—Pyrodust 4,000 and Pyrocolloid (1 : 1000), were tried against various

pests in several kitchen gardens in New Delhi. Pyrodust 4000 proved highly effective against Red pumpkin beetle, Aphids and Jassids and in all cases the population of the pest was considerably reduced. Pyrocolloid (1 : 1000) also gave good results and mortality of *Epilachna* beetle grubs and aphids was even more than 80 per cent in some cases.

Pyrethrum products are harmless to man and also leave no ill-effect on the plants. In many cases formulations may compare very well with other insecticides of synthetic nature. (Dte. P. P. Q. & S.)

U. S. Tests Show Sprays Superior to Dusting in Cotton Insect Control

Experiments with new synthetic insecticides indicate that cotton growers may be able to shift from dusting to spraying for control of insects, says the United States Department of Agriculture. Research now being conducted shows that the sprays can be applied effectively by mechanical means, eliminating labour and time—consuming dusting-methods now in use

Experiments are being pushed to perfect equipment and test the best formulations of the new insecticides—DDT, benzene hexachloride, toxophene and parathion. In one phase of the work, entomologists and agricultural engineers are testing spray equipment attached to tractor-driven cultivators to make insect control a part of the tillage operations.

Experiments with aeroplane applications of the new insecticides reveal that very small quantities of concentrated sprays applied in the air blast from the planes controlled several cotton pests as well or better than more diluted sprays from ground equipment.

The Department notes that success of the spraying research would permit growers to do away with an onerous task of cotton production—pest control by dusting with calcium arsenate. This has been the standard practice in U.S. Cotton fields for more than 30 years and often stretches the " cotton work day " to 16 or 18 hours. The best dusting time is before and after the usual working hours—dawn, dusk and night—when wind movement is the least- (Extract from *American News File. Agri. Supp.*, 1949, 49-A-III, pp. 6 7)

Oriental Fruit Fly

California has recently enacted into law a Bill designed to prevent the introduction of Oriental fruit fly into the State. This pest has recently spread rapidly over the Hawaiian Islands and there is imminent danger that it may be introduced and spread in the United States. According to the law, " precautionary measures of the greatest intensity must therefore be taken to detect the presence of this pest immediately upon its arrival within the State and to destroy the pest and the host plants which harbor it, without delay ".

Dr. Walter Carter, head of the Pine-apple Research Institute of Hawaii has been placed in charge of Oriental fruit fly research for the United States government, with headquarters in Honolulu. Extract from *Nat. Agric. Chem. Assc. News*, 1949 (5) : 2)

Insect-Proofing of Cotton Bags with Pyrethrum Products

One of the sources of insect infestation of grain is the bag itself. Generally the infestation occurs of insects like *khapra* larvae which remain hidden in seams or keep clinging to the fibre between the meshes. They attack fresh grain when it is filled in such infested bags. But sometimes it so happens that insects thrust their ovipositors through the fabric and deposit their eggs in the food material within, or the small larvae may crawl through needle holes along the seams and at the top of the bags, or directly through the meshes of the fabric.

In order, therefore, to find a suitable repellent which could be applied to the bag fabric and keep off the insects, tests were made at Manhattan, Kans., laboratory of the Bureau of Entomology and Plant Quarantine. The repellents included solutions of 1-500 nicotine or 2 per cent solution of sodium silicofluoride, DDT and pyrethrin with Piperonyl butoxide. The insects employed in these trial were *Laemophloeus minutus, Tribolium confusum, Tenebroides mauritanicus* and *Ephestia kuhniella.* The experiments were made on bags made from cotton.

It is reported* that of the chemicals tried, light dosage of Pyrethrin (1-10) alone or mixed with Piperonyl butoxide afforded protection to flour packed therein against insect infestation for at least 7 months. These chemicals are of comparatively low order of toxicity to warm blooded animals, and it seems unlikely that at the rates and with methods used in these experiments there is any danger of contamination of products packed in treated bags. However, further work is in progress to determine an effective minimum dosage. Treated cloth is not materially changed in appearance. Pyrethrin gives slight but no objectionable odour.

Cotton Bags made Insect Repellent

A new chemical treatment which makes cotton bags insect repellent has been found by scientists of the U. S. Department of Agriculture. The discovery, according to Department scientists and Industry representatives may hold tremendous value in conserving flour and other cereal products.

Scientists tested the treatment by exposing both treated and untreated bags containing insect free flour for a long period of time in a room containing thousands of hungry flour beetles and moths. In one such test, bags made of treated cloth admitted no insects during seven months while an untreated bag let in 563 insects.

The insect-repellent treatment consists of pyrethrins or a mixture of pyrethrins and piperonyl butoxide—two insecticides that are of comparatively low toxicity to warm-blooded animals. Tests to date indicate that food packed in properly treated bags is unlikely to be contaminated with these chemicals, but further investigation is needed

The Textile Bag Manufacturers Association and several large bags manufacturers are interested in the commercial use of this treatment. Extract from *N.A.C. Assoc.* News, 1949 (5)7 : 4]

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* Cotton R. T., Frankenfeld J. C. & Stickland W.B., *U. S. D. A. Agric. Res. Admn. Bur Ent. & Plant Quarantine,* July 1949.

FAO Launches World Pest Control Programme

The Food and Agriculture Organisation of the United Nations has started a project designed to reduce world-wide losses of food by insects, fungi and rodents.

Stephen S. Easter, FAO Entomologist, is leading the educational campaign designed to save food.

Rodent and insect control in India is now being carried out with the latest equipment and improved methods of control.

A recent pest control training school, held under the auspices of FAO was conducted in Palmira, Columbia. Another activity reported is an on-the-spot assistance programme for scientists in countries that are losing food due to rodents and insect infestation.

The FAO has been helping to check locust infestations in Turkey and Guatemala, while in Poland it has outlined a control programme for the Colorado beetle that has been ravaging the potato crop. [Extract from *N.A.C. Assoc. News*, 1949 7(5) ; 4

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